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No. IV.

TORNADOES OF MAY 29TH AND 30TH, 1879.

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Report of the tornadoes of
May 29 and 30, 1879 ...

V

UNITED STATES OF AMERICA,

WAR DEPARTMENT.

PROFESSIONAL PAPERS OF THE SIGNAL SERVICE

No. 4.

REPORT

OF THE

TORNADOES OF MAY 29 AND 30, 1879,

IN

KANSAS, NEBRASKA, MISSOURI, AND IOWA,

BY

SERGEANT J. P. FINLEY,

SIGNAL CORPS, U. S. A.

PREPARED UNDER THE DIRECTION OF

BRIG. AND BVT. MAJ. GEN. W. B. HAZEN

CHIEF SIGNAL OFFICER OF THE ARMY.

PUBLISHED BY AUTHORITY OF THE SECRETARY OF WAR.

WASHINGTON:

GOVERNMENT PRINTING OFFICE

1881.

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NOTE.

The publication of this Memoir in the present series of Professional Papers is to be considered merely as a means of bringing it before the attention of the scientific world, and not in any way as an indorsement of the views or theories therein set forth.

OFFICIAL LETTER.

War Department, Office of the Chief Signal Officer,
Washington, D. C., September 25, 1879.

General: In compliance with your instructions, as detailed in Special Orders No. 88, Office of the Chief Signal Officer, I have the honor to present herewith the report of my investigations of the tornadoes of May 29 and 30, in the States of Kansas, Missouri, Nebraska, and Iowa.

While pursuing my labors, unexpected and unusual difficulties forced themselves in the way of as complete and satisfactory a prosecution of the work as I had contemplated, a result in part, from the occurrence of almost incessant rains, accompanied by some of the most severe wind and hail storms that ever visited the Lower Missouri Valley. Hardly three days out of an entire month was the weather at all pleasant or conducive to good work. Bridges were washed away, streams swollen to rushing rivers, and roads turned into soft, sinking morasses, almost impassable to man or beast, yet in twenty days I traveled (exclusive of railroad transit) over 500 miles with horse and buggy, and also did considerable walking.

This condition of the country made it at times impossible to visit portions of the storm tracks from which I could have gathered valuable information, thus compelling me to rely too often upon second-hand evidence, although in every instance I did not fail to make strenuous efforts in every possible manner to verify it.

The heavy winds and rains which prevailed over this section of country from the 1st to the 12th of June obliterated much of the evidence distinguishing the tracks of the several tornadoes, causing destruction in the vicinity of and at times over the same paths which they had pursued, making the work of investigation often perplexing in the extreme.

Again, the lateness at which I arrived at the first storm track (ten days after its formation, and, of course, correspondingly later at the others) is a matter which might seem of very little moment to the casual observer, but which made no inconsiderable difference concerning the ease and completeness with which the work was prosecuted. People had commenced to rebuild their houses; fences, with hardly an exception, were replaced; fields were recultivated; the *débris* was picked up in piles or entirely removed, all of which rendered it quite difficult to obtain the truth in every instance.

I have endeavored to the best of my ability to collect nothing but the facts, under a condition of mind free from predisposition to any theory, and in their presentation to confine myself to an intelligible arrangement of them. In several instances results have been presented that naturally offered themselves, and really demanded utterance as a completion of the sense.

Very respectfully,

JOHN P. FINLEY,
Private, Signal Corps, U. S. A.

Albert J. Myer,
Brigadier-General (Brevet Assigned) and Chief Signal Officer, U. S. A.

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EXHIBIT D,
A PARTIAL OUTLINE MAP
OF THE
STATES OF KANSAS, NEBRASKA, IOWA
and
MISSOURI,
SHOWING THE COURSES OF THE TORNADOES
of
MAY 29th and 30th 1879.

No I. Buffalo Creek Tornado.	No VIII. Stockdale Tornado.
No II. Lincoln County "	No IX. Clarinda " "
No III. Delphos " "	No X. Barnard " "
No IV. Pipe Creek " "	No XI. Gentry "
No V. Wakefield " "	No XII. Hackberry Ridge " "
No VI. Waterville " "	No XIII. Lees Summit " "
No VII. Irving " "	

99° 98° 97° 96° 95° 94°
41° 40° 39° 38°
West from Greenwich

PLATTE R.
Republican River
Little Blue R.
Blue River
Big Blue River
Nemaha River
Nodaway River
One Hundred and Two R.
Platte River
Grand River
Crooked Cr.
Grand R.
Big Stranger R.
Delaware Cr.
Cottonwood Cr.
Osage River
MISSOURI RIVER
KANSAS RIVER

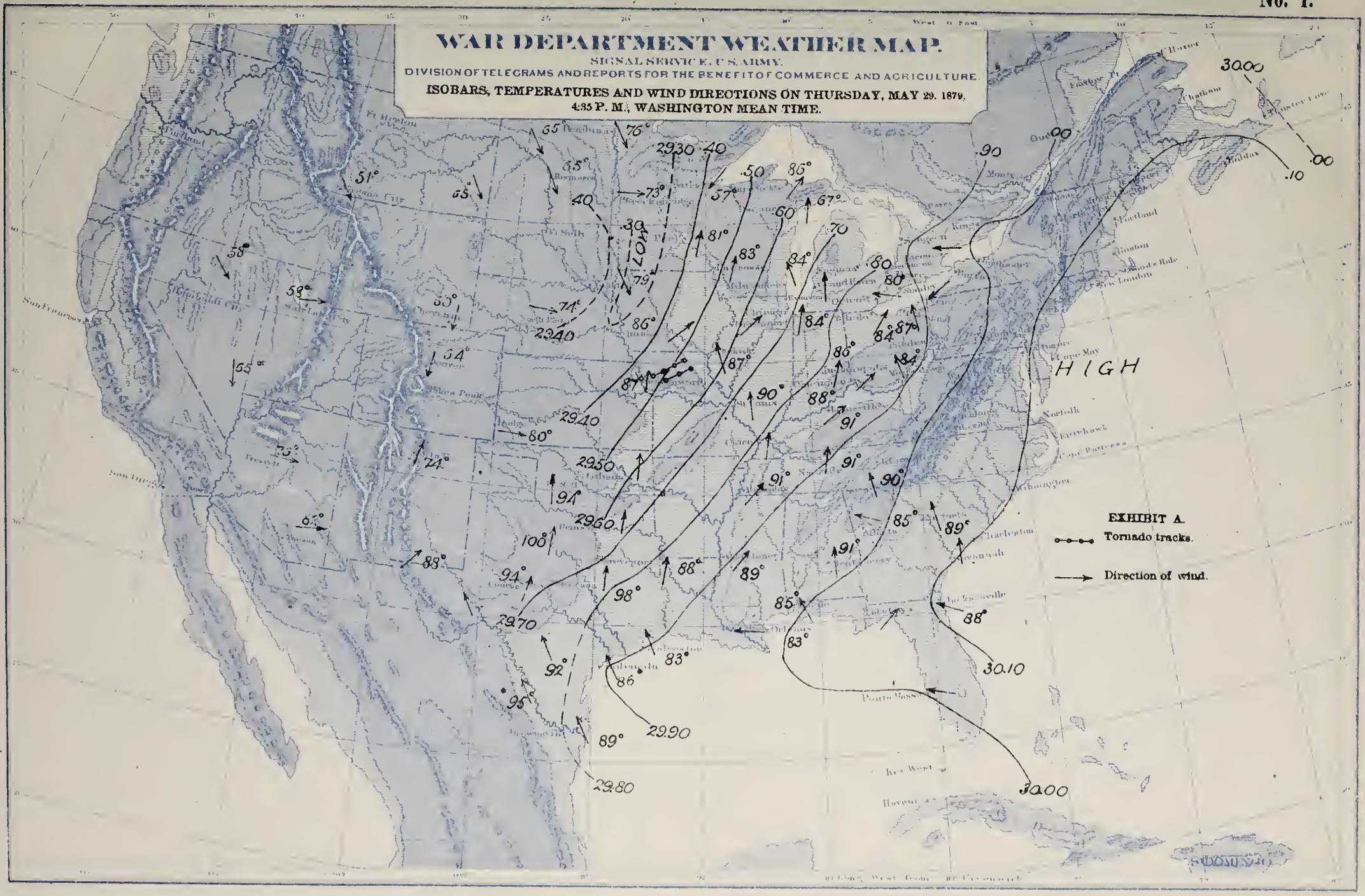
IOWA
NEBRASKA
KANSAS
MISSOURI

Snow Hill
Clarinda
Barnard
Albany
Dawson's Mills
Sarahnah
West Hope
Elm Creek
Waterville
Irving
Riley Centre
Wild Cat
Manhattan
Malta
Grover
Wakefield
Minneapolis
Delphos
Milo
Lincoln Centre
Salina
Lees Summit
Greenwood
Sibley
Kansas City

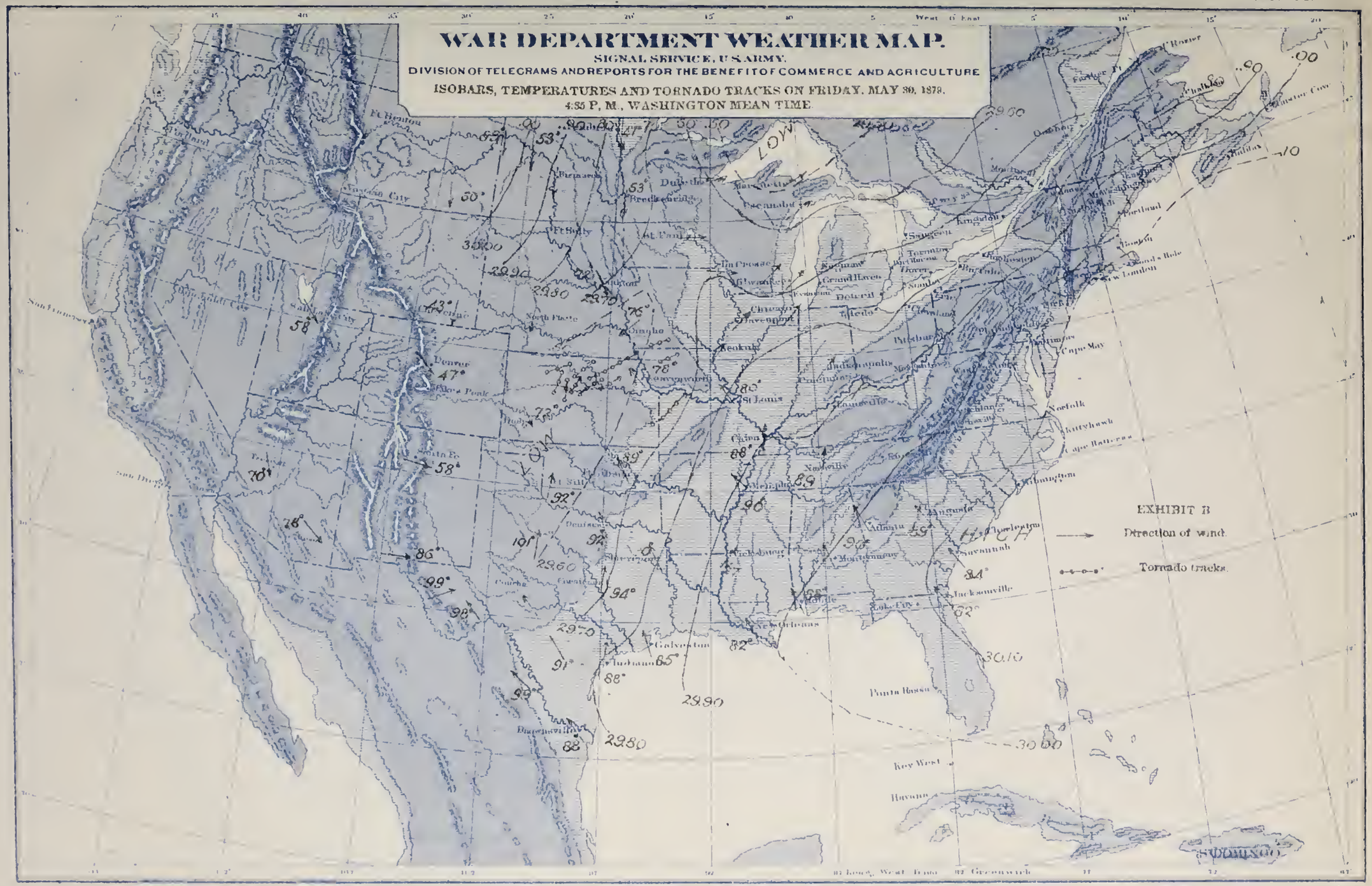
No I
No II
No III
No IV
No V
No VI
No VII
No VIII
No IX
No X
No XI
No XII
No XIII

1

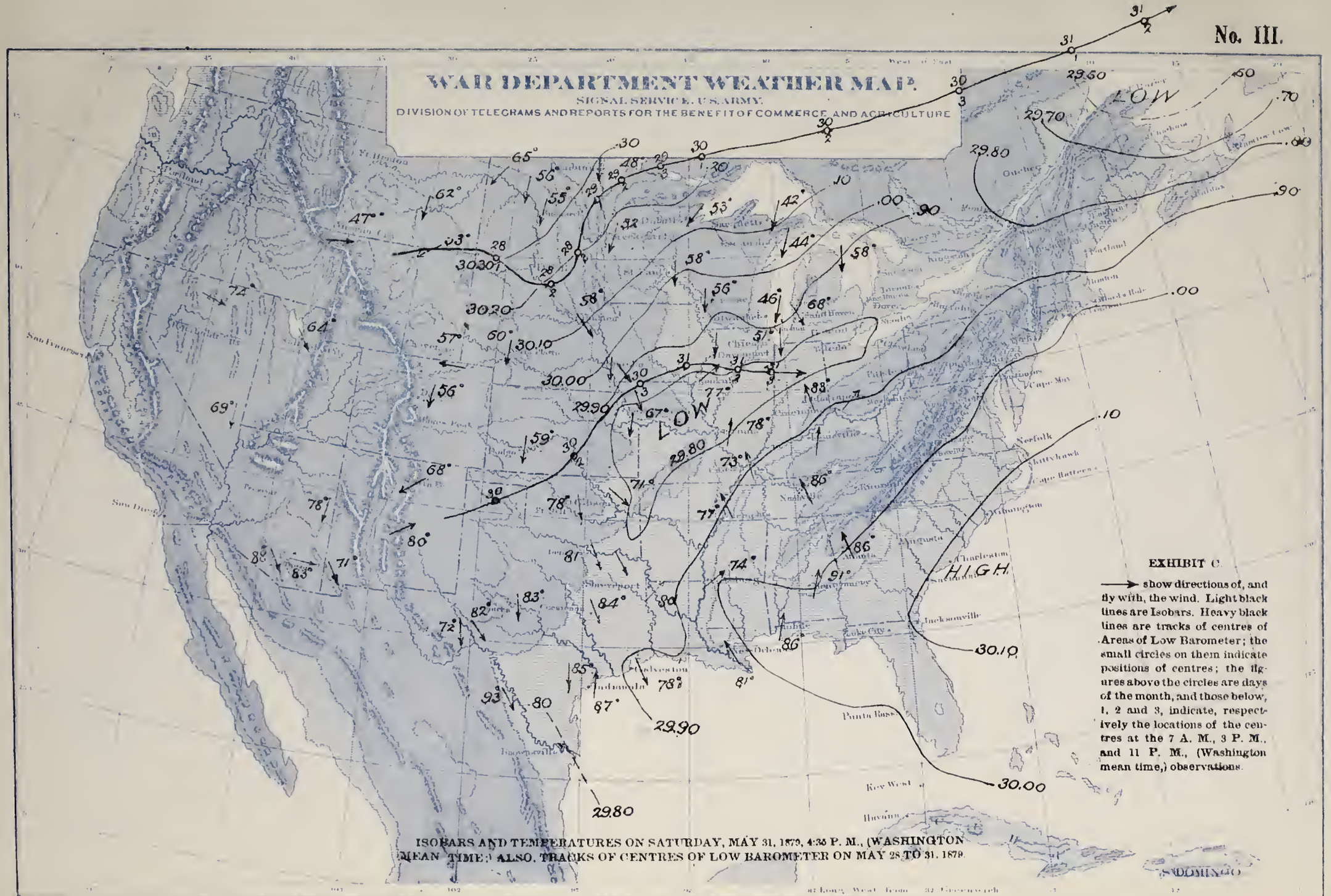
No. I.


WAR DEPARTMENT WEATHER MAP.
SIGNAL SERVICE, U.S. ARMY.
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.
ISOBARS, TEMPERATURES AND WIND DIRECTIONS ON THURSDAY, MAY 29. 1879.
4:35 P. M., WASHINGTON MEAN TIME.
HIGH
EXHIBIT A.
Tornado tracks.
Direction of wind.
29.30
29.40
29.50
29.60
29.70
29.80
29.90
30.00
30.10

2


WAR DEPARTMENT WEATHER MAP.
SIGNAL SERVICE, U.S.ARMY.
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE
ISOBARS, TEMPERATURES AND TORNADO TRACKS ON FRIDAY, MAY 30, 1879.
4:35 P. M., WASHINGTON MEAN TIME.
LOW
HIGH
EXHIBIT B
Direction of wind.
Tornado tracks.

No. III.


WAR DEPARTMENT WEATHER MAP.
SIGNAL SERVICE, U.S. ARMY.
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE
LOW
LOW
HIGH
29.60
29.70
29.80
29.90
30.00
30.10
.50
.70
.80
.90
.00
.10
EXHIBIT C.
→ show directions of, and fly with, the wind. Light black lines are Isobars. Heavy black lines are tracks of centres of Areas of Low Barometer; the small circles on them indicate positions of centres; the figures above the circles are days of the month, and those below, 1, 2 and 3, indicate, respectively the locations of the centres at the 7 A. M., 3 P. M., and 11 P. M., (Washington mean time,) observations.

ISOBARS AND TEMPERATURES ON SATURDAY, MAY 31, 1879, 4:35 P. M., (WASHINGTON MEAN TIME.) ALSO, TRACKS OF CENTRES OF LOW BAROMETER ON MAY 28 TO 31, 1879.

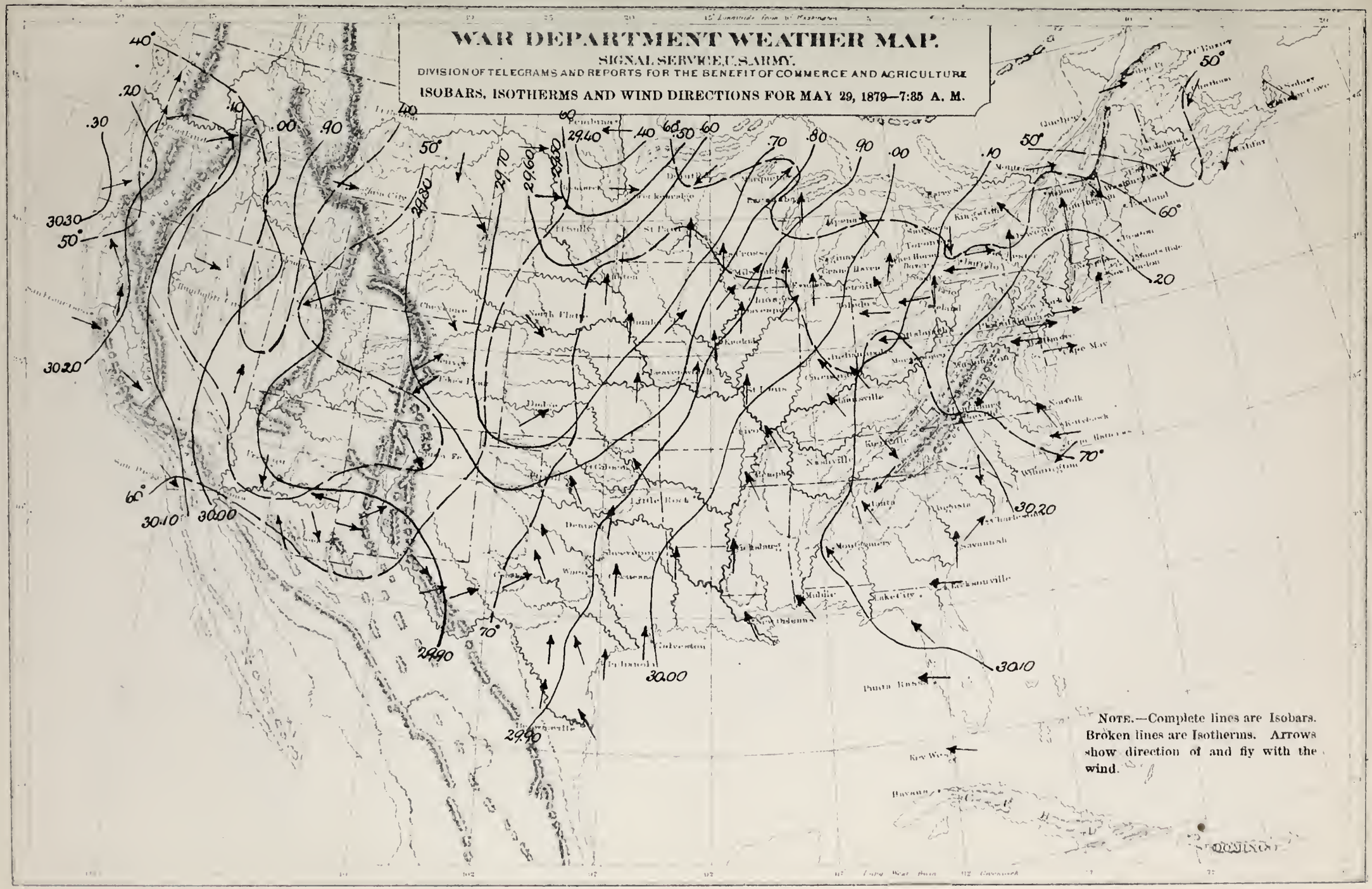
WAR DEPARTMENT WEATHER MAP.

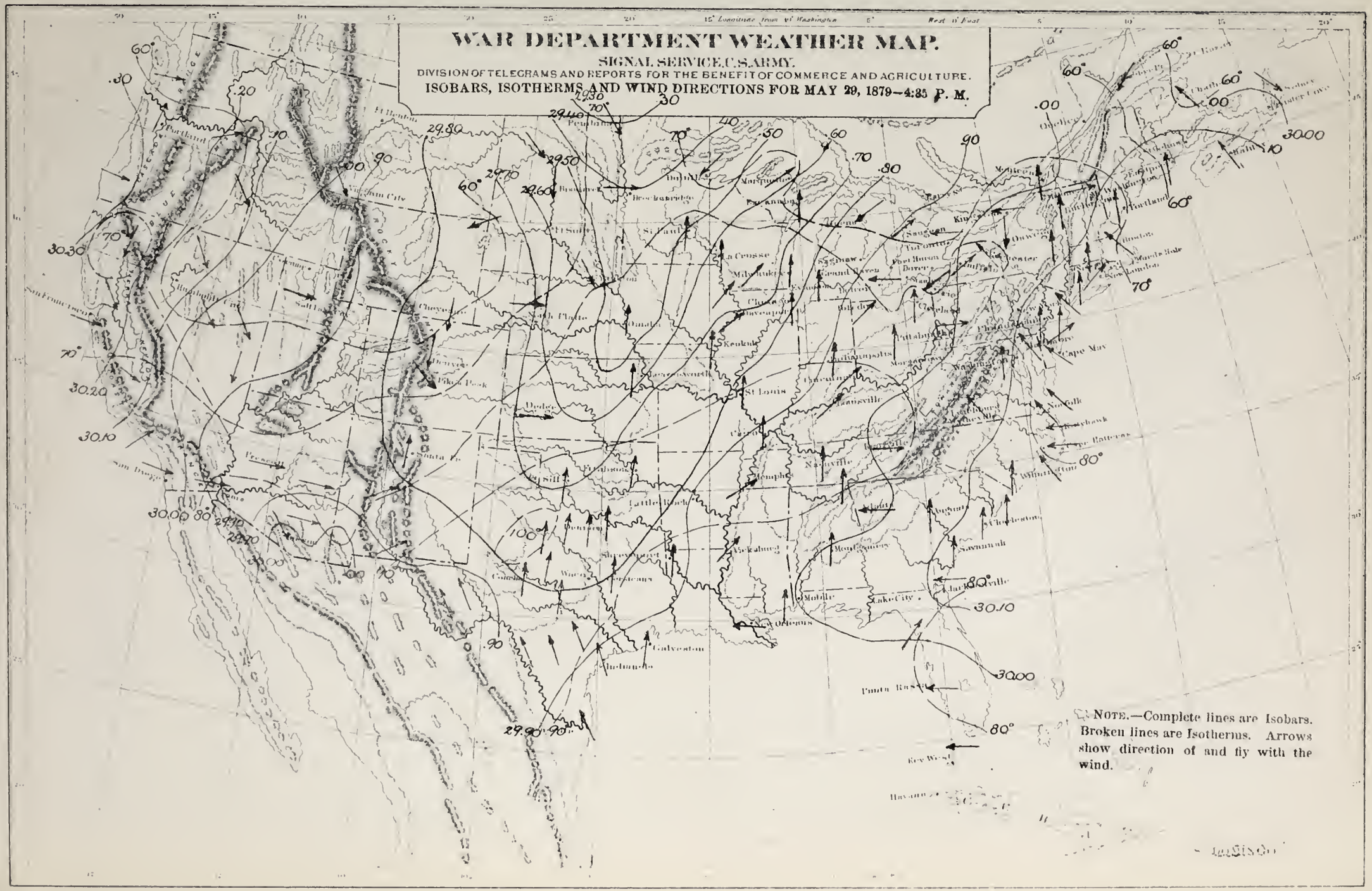
SIGNAL SERVICE, U.S. ARMY.

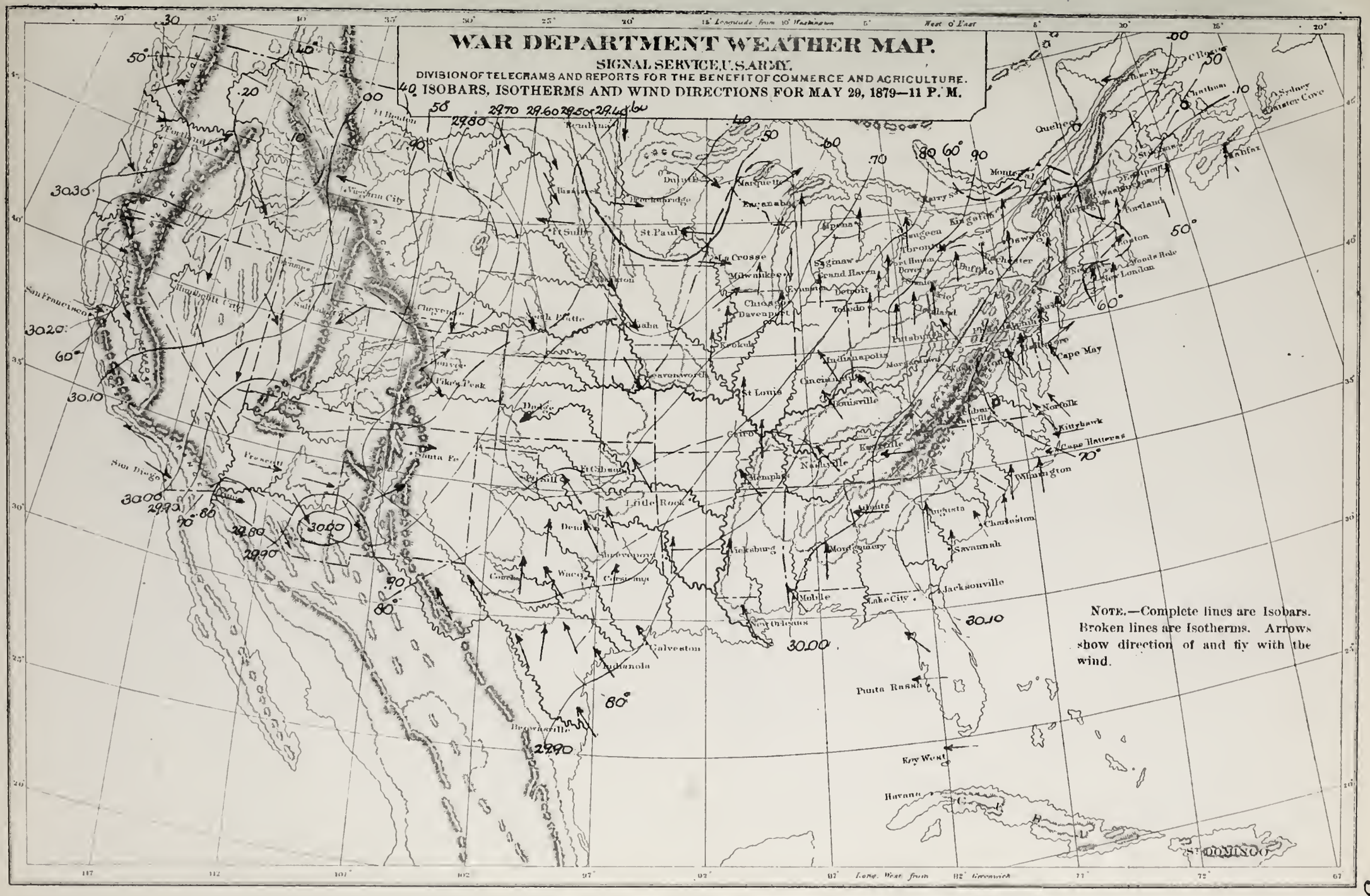
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

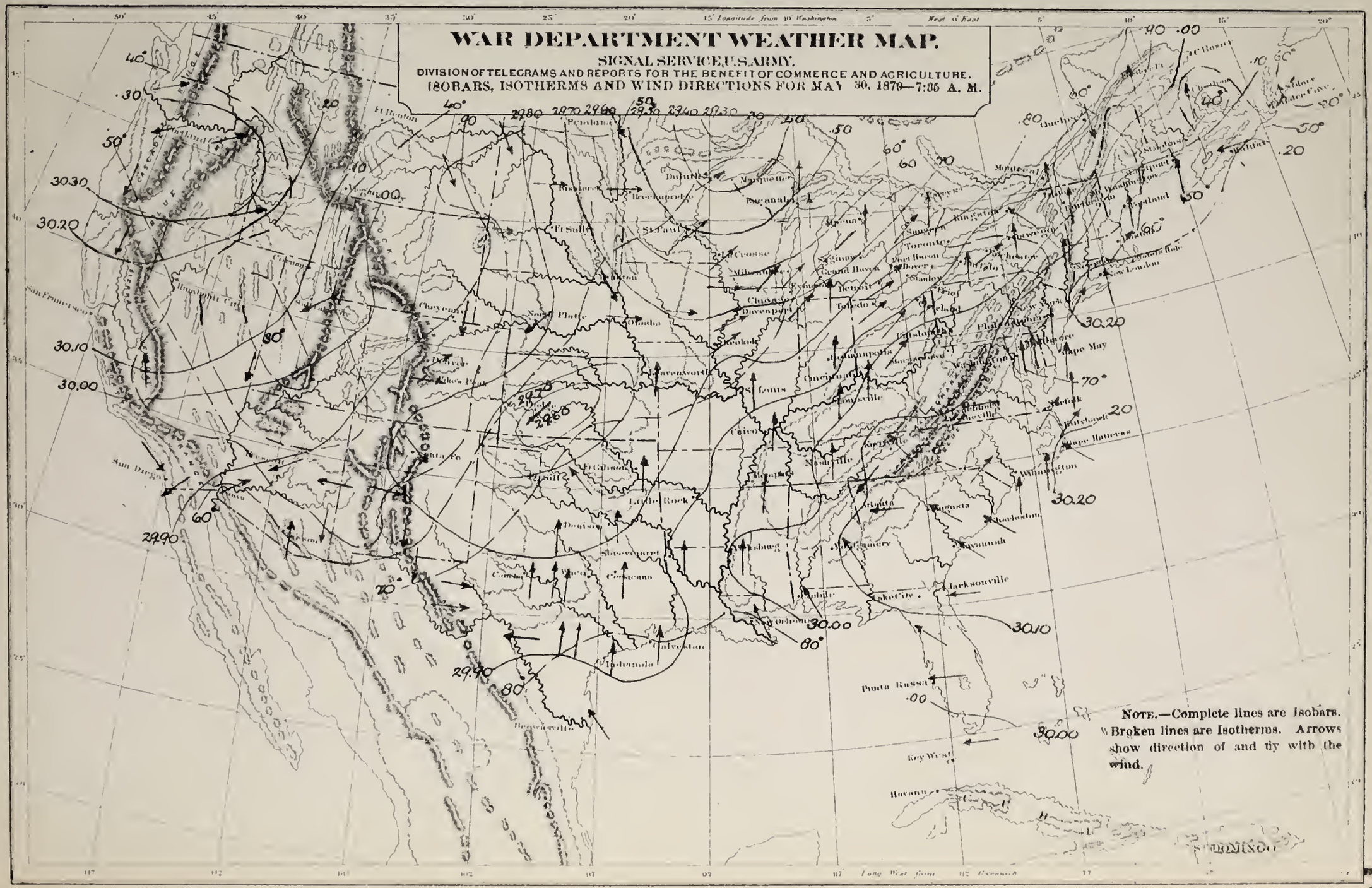
ISOBARS, ISOTHERMS AND WIND DIRECTIONS FOR MAY 28, 1879—4:35 P. M.

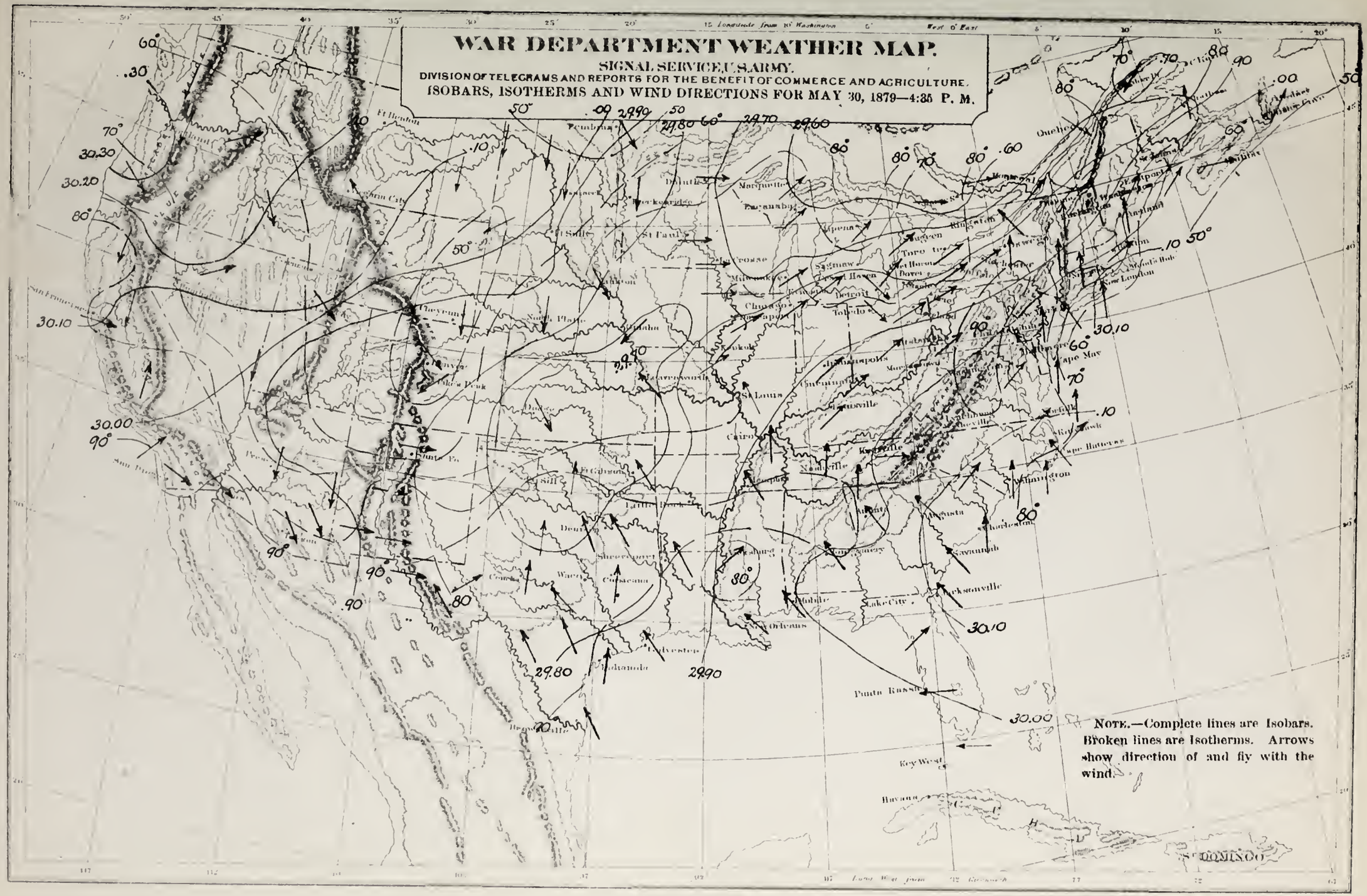
NOTE.—Complete lines are Isobars. Broken lines are Isotherms. Arrows show direction of and fly with the wind.

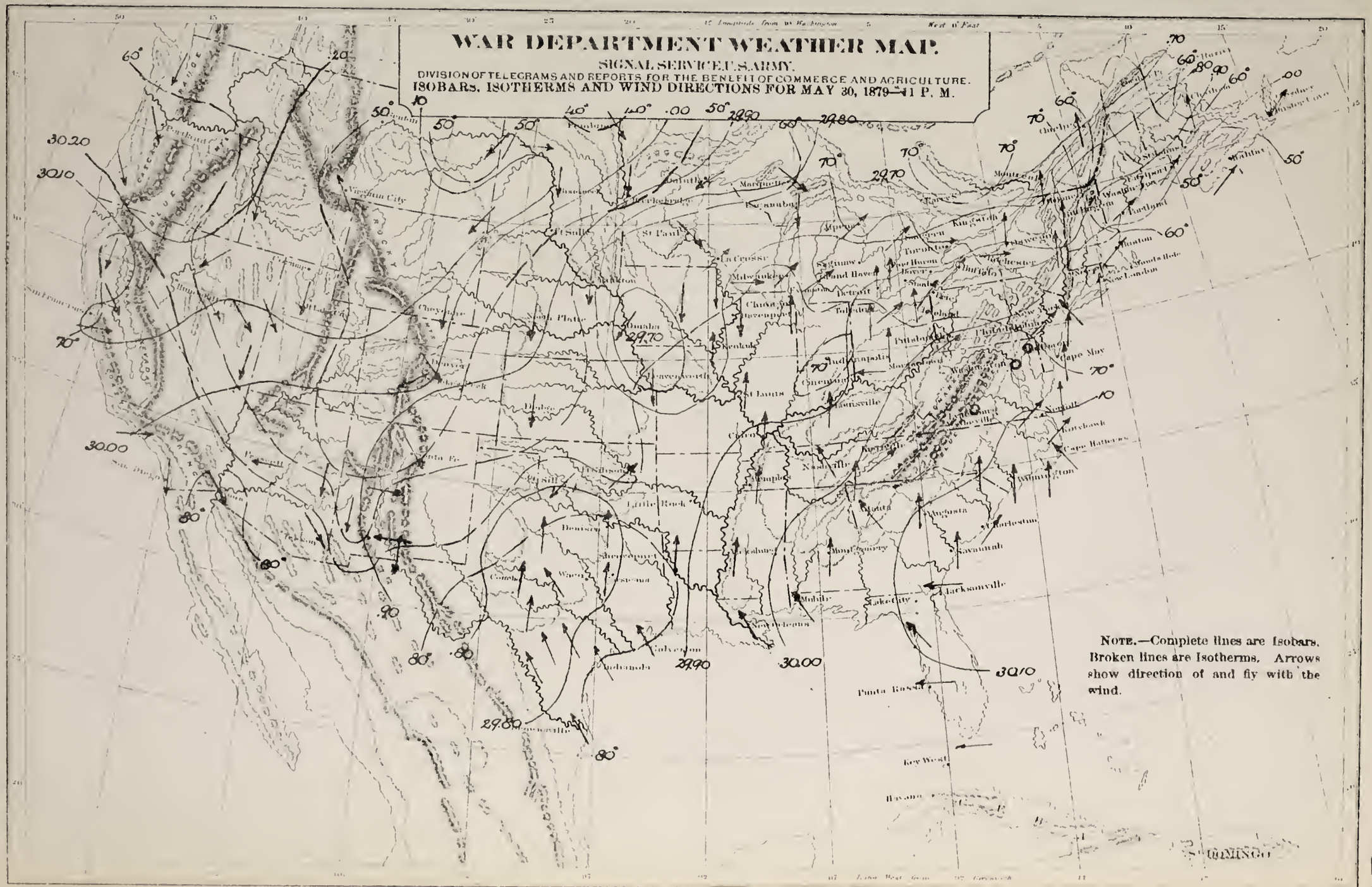

WAR DEPARTMENT WEATHER MAP.
SIGNAL SERVICE U.S.ARMY.
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE
ISOBARS, ISOTHERMS AND WIND DIRECTIONS FOR MAY 29, 1879—7:35 A. M.
NOTE.—Complete lines are Isobars. Broken lines are Isotherms. ARROWS show direction of and fly with the wind.

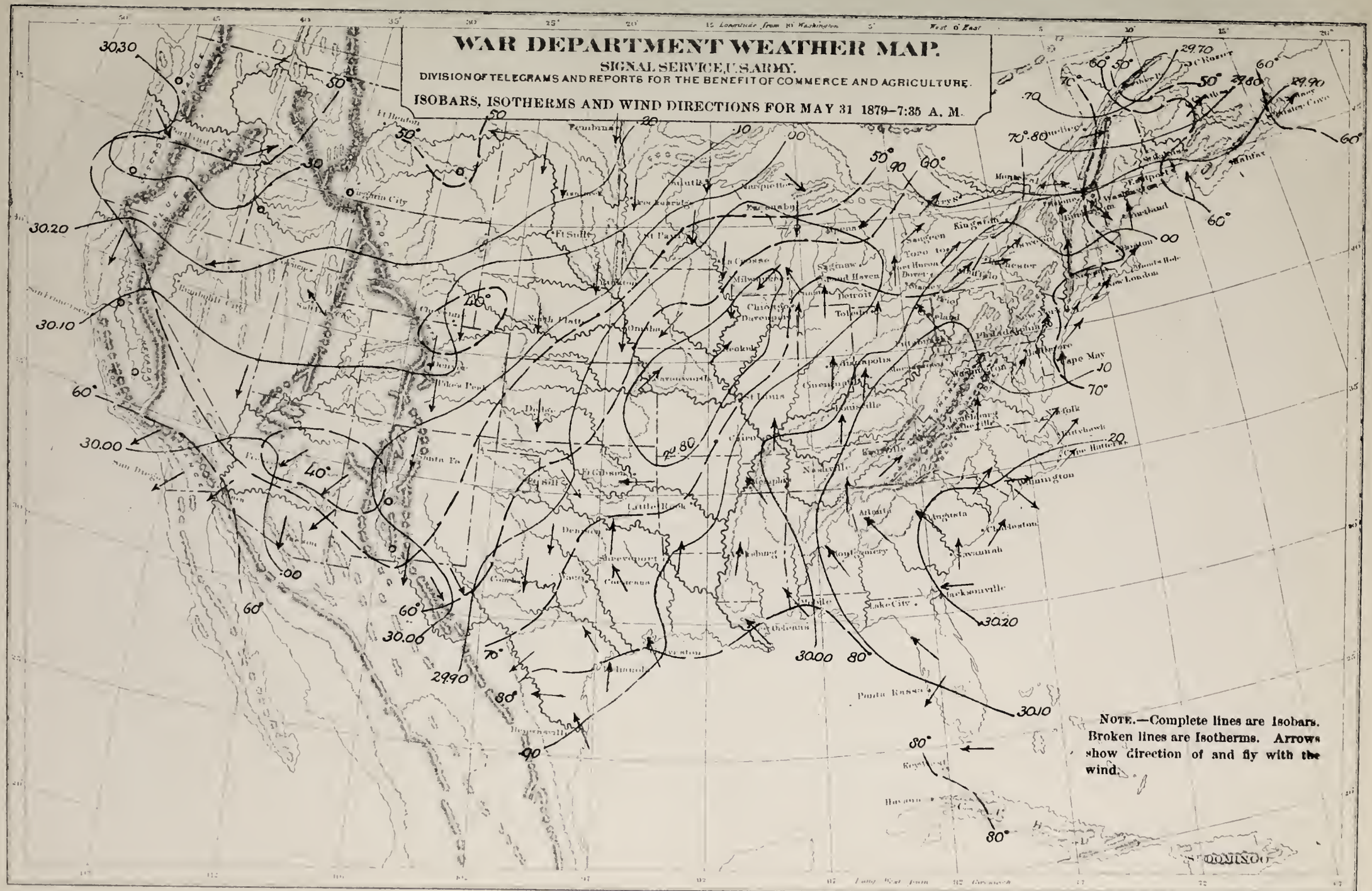

WAR DEPARTMENT WEATHER MAP.
SIGNAL SERVICE, U.S. ARMY.
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.
ISOBARS, ISOTHERMS AND WIND DIRECTIONS FOR MAY 29, 1879—4:35 P. M.
15° Longitude from W. Washington 5° West to East
NOTE.—Complete lines are Isobars. Broken lines are Isotherms. Arrows show direction of and fly with the wind.


WAR DEPARTMENT WEATHER MAP.
SIGNAL SERVICE, U.S. ARMY.
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.
ISOBARS, ISOTHERMS AND WIND DIRECTIONS FOR MAY 29, 1879—11 P. M.
NOTE.—Complete lines are Isobars. Broken lines are Isotherms. Arrows show direction of and fly with the wind.
Longitude from Washington
West of Greenwich
Long. West from
ST DOMINGO


WAR DEPARTMENT WEATHER MAP.
SIGNAL SERVICE, U.S. ARMY.
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.
ISOBARS, ISOTHERMS AND WIND DIRECTIONS FOR MAY 30, 1879—7:35 A. M.
NOTE.—Complete lines are Isobars. Broken lines are Isotherms. Arrows show direction of and fly with the wind.


WAR DEPARTMENT WEATHER MAP.
SIGNAL SERVICE, U.S. ARMY.
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.
ISOBARS, ISOTHERMS AND WIND DIRECTIONS FOR MAY 30, 1879—4:35 P. M.
NOTE.—Complete lines are Isobars. Broken lines are Isotherms. Arrows show direction of and fly with the wind.
ST DOMINGO


WAR DEPARTMENT WEATHER MAP.
SIGNAL SERVICE, U.S. ARMY.
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.
ISOBARS, ISOTHERMS AND WIND DIRECTIONS FOR MAY 30, 1879—1 P. M.
NOTE.—Complete lines are Isobars. Broken lines are Isotherms. Arrows show direction of and fly with the wind.
30.20
30.10
30.00
29.90
29.80
29.70
29.90
30.00
30.10
Punta Rassa
Key West
Havana
St Domingo
Cape May
Cape Hatteras
Jacksonville
Lake City
Mobile
New Orleans
Galveston
Indianola
Brownsville
Corpus Christi
Little Rock
Memphis
Nashville
Cincinnati
St Louis
Omaha
Leavenworth
Kenrick
Chicago
Milwaukee
Detroit
Toledo
Buffalo
Oswego
Rochester
Albany
Boston
Portland
Eastport
Halifax
St Paul
La Crosse
Duluth
Marquette
Escanaba
Mackinaw
Grand Haven
Port Huron
Cleveland
Erie
Pittsburgh
Harrisburg
Philadelphia
New York
Washington
Norfolk
Wilmington
Charleston
Savannah
Augusta
Atlanta
Montgomery
Vicksburg
Shreveport
Dallas
Denison
Fort Sill
Fort Elliott
Santa Fe
Cheyenne
North Platte
Yankton
Fort Custer
Fort Benton
Helena
Virginia City
Winnemucca
Salt Lake City
Fort Bridger
Fort Garland
Fort Wingate
Fort Whipple
Fort Mojave
Fort Yuma
San Diego
San Francisco
Sacramento
Portland
Walla Walla
Fort Colville
Fort Steilacoom
Port Townsend
Victoria
Winnipeg
Moorhead
Fort Pembina
Fort Assiniboine
Fort Maginnis
Fort Ellis
Fort Shaw
Fort Missoula
Fort Custer
Fort Keogh
Fort Buford
Fort Totten
Fort Abercrombie
Fort Ridgely
Fort Snelling
Fort Dodge
Fort Sidney
Fort McPherson
Fort Hartsuff
Fort Omaha
Fort Niobrara
Fort Randall
Fort Sully
Fort Pierre
Fort Bennett
Fort Meade
Fort Laramie
Fort Fetterman
Fort Steele
Fort Washakie
Fort Bridger
Fort Douglas
Fort Duchesne
Fort Lapwai
Fort Walla Walla
Fort Colville
Fort Steilacoom
Fort Townsend
Fort Canby
Fort Klamath
Fort Bidwell
Fort Crook
Fort Gaston
Fort Humboldt
Fort Ross
Fort Point
Fort Mason
Fort Yuma
Fort Lowell
Fort Grant
Fort Bowie
Fort Stanton
Fort Union
Fort Wingate
Fort Garland
Fort Lyon
Fort Dodge
Fort Riley
Fort Leavenworth
Fort Scott
Fort Gibson
Fort Smith
Fort Arbuckle
Fort Sill
Fort Elliott
Fort Bascom
Fort Union
Fort Marcy
Fort Craig
Fort Bayard
Fort Lowell
Fort Grant
Fort Bowie
Fort Stanton
Fort Union
Fort Wingate
Fort Garland
Fort Lyon
Fort Dodge
Fort Riley
Fort Leavenworth
Fort Scott
Fort Gibson
Fort Smith
Fort Arbuckle
Fort Sill
Fort Elliott
Fort Bascom
Fort Union
Fort Marcy
Fort Craig
Fort Bayard


WAR DEPARTMENT WEATHER MAP.
SIGNAL SERVICE, U.S. ARMY.
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.
ISOBARS, ISOTHERMS AND WIND DIRECTIONS FOR MAY 31 1879—7:35 A. M.
Longitude from 90° Washington 5° West 0° East
30.30
30.20
30.10
30.00
30.06
29.90
29.80
29.70
29.90
30.00
30.10
30.20
NOTE.—Complete lines are Isobars. Broken lines are Isotherms. Arrows show direction of and fly with the wind.

REPORT

OF THE

TORNADOES OF MAY 29 AND 30, IN THE STATES OF KANSAS, MISSOURI, NEBRASKA, AND IOWA.

INTRODUCTION.

In order to obtain a reasonable knowledge of the general atmospheric conditions preceding and accompanying the development of this remarkable series of storms, it becomes necessary to review the successive changes as presented in the accompanying Signal Service weather maps, which explain themselves, and to which little can be added in a descriptive sense to make the presentation of the central truth more apparent. In consulting the same, it will be observed that two areas of low pressure accompanied the formation and continuation of the local storms. The first of these appeared on the morning of the 28th to the west of Manitoba, attended by light rains and warm southerly winds over the northern portion of Dakota and southeastward throughout Minnesota, the western portion of Wisconsin, and the northern portion of Iowa. Clear or fair weather, with southerly winds, prevailed southward to the Gulf and eastward to the Mississippi, and the isotherm of 70° traversed the central portions of Texas, Indian Territory, and Kansas. Over the Territories of Wyoming and Montana the winds veered to light westerly with a slight fall in temperature, foretelling the decided change which the morrow would inaugurate.

On the morning of the 29th the area of lowest pressure extended from Southern Manitoba to Northern Iowa, with southerly, backing to easterly, winds and light rain. Throughout the extreme Northwest and the Northern Rocky Mountain slope the winds had shifted to brisk NW., and the temperature fell from 8° to 10° at all stations. At 4.35 p. m. (Washington mean time—and this time is indicated whenever the figures 7.35 a. m., 4.35 p. m., and 11 p. m. are used, other figures show local time) the low area was still occupying very nearly the same position, but the winds to the north of its center had changed from NE. to NW., and occasional thunder-storms were reported.

To the west of its center the NW. winds had increased in force from 4 to 20 miles per hour at different stations, so affecting the temperature that the instruments barely indicated the accustomed daily range. At Fort Keogh, Mont., a temperature of 53° was reported at 7.35 a. m., and 52° at 4.35 p. m., with a precipitation of 0.01 inch. The highest temperature N. of the 40th parallel and between the 102d and 112th meridians was 60° and the lowest 52°. Pike's Peak reported a NW. wind of 20 miles per hour, exposed thermometer 31°; upper clouds hidden and lower clouds (stratus) moving from the SW.

South of parallel 40°, and between the 92d and 102d meridians, every station reported a S. or SE. wind, and the temperatures ranged from 81° to 100°, the majority being above 92°. Those stations farthest north reported the highest temperatures. Here is presented a contrast in temperature of from 30° to 45°, and in the case of Pike's Peak (31°, wind NW.) as compared with Fort Griffin, Tex. (100°, wind S.), a difference of 69°.

At this hour (4.35 p. m.), and while the contest of opposing warm and cold currents was vigorously proceeding, occurred two of the destructive tornadoes of Northwestern Missouri. By midnight the temperatures throughout the Northern and Middle Eastern Rocky Mountain slopes had fallen from 4° to 18°, and snow was reported on the summit of Pike's Peak, with a brisk NW. wind and a temperature of 21°. The contrast of temperature north and south of parallel 37° still remained about the same. Throughout the eastern and western portions of Missouri and Kansas the temperature had fallen about 20°, with the winds shifting to westerly.

On the morning of the 30th the lowest pressure was central over the western portion of Lake Superior, accompanied with light rains as far south as Missouri and Kansas, and westward to Colorado and Wyoming. Throughout the Northern and Middle Eastern Rocky Mountain slopes the winds were N. to W. and the temperature ranged from 40° at Virginia City, Mont., to 55° at North Platte, Nebr., and 13° on summit at Pike's Peak.

South of parallel 37° the temperatures ranged from 75° to 82°, with southerly winds. The cold westerly winds passing down in rear of the low area, which was moving to the NE., now embraced a larger territory, and swept forward with more freedom to engage in conflict with the warm currents from the Gulf as they passed northward over Texas, presenting the first indications of the development of a second low area. By 4.35 p. m. this area extended from Northwestern Texas northeastward to Central Iowa, attended with very light precipitation over its northern half, and brisk winds to gales to the W. and S. Fort Sill, S. 28 miles; Fort Gibson, SE. 24; Denison, Tex., SE. 20; Cheyenne, N. 22; Dodge City, NW. 44; and North Platte, N. 28. The first low area was now central over the Upper Lake region and but slightly affecting the atmospheric conditions over the Lower Missouri Valley. Over the Northern and Middle Eastern Rocky Mountain slopes cold NW. winds still prevailed with hardly a perceptible change since morning, although it was but little past the hottest part of the day. The temperature at Cheyenne still remained at 43°, and Denver rose but 1°. Pike's Peak was now 15°, with a NE. wind and light snow.

To the southward of parallel 37° the temperatures were nearly all above 90°, and Fort Griffin reported 101°, with a S. wind. From this hour (4.35 p. m.) up to 7 p. m. occurred the violent tornadoes in Kansas, Nebraska, and Missouri. By 8 p. m. the winds throughout the Lower Missouri Valley had changed to N. and W., and the temperature fell from 10° to 14°. In Central and Eastern Kansas and Western Missouri frost was reported during the night in many places. To the N. and W. of this district the temperatures remained low, with brisk N. to W. winds. At 11 p. m. Cheyenne reported wind N., temperature 43°; Denver, NW., 48°; Pike's Peak, NE., 15°, with light snow; Santa Fé, NW., 48°; Fort Keogh, NE., 45°; Fort Benton, NE., 48°; Fort Stevenson, N., 45°; Bismarck, N., 46°; Fort Gary, N., 38°; Pembina, NW., 40°; and Breckinridge, N., 47°.

During the 31st the barometer rose rapidly over the Northern and Middle Eastern Rocky Mountain slopes, with still lower temperatures, particularly over Central and Western Kansas, where high winds to gales prevailed from the NW. At 7.35 a. m. Pike's Peak reported a temperature of 10° with fair weather. To the southward over Indian Territory and Texas, the winds by afternoon had changed to N. and NW., with a decided fall in temperature. Low area No. I had now reached the Gulf of Saint Lawrence, while No. II had formed an irregular elongated "barometric trough" extending from Southern Michigan southwestward to Arkansas, accompanied with moderately heavy rains and brisk to high winds from the Mississippi Valley eastward to the Middle Atlantic States.

It will be of interest to note the fact that throughout the Lower Missouri Valley, the region of the violent storms, there occurred no unusual fall in the barometer during the entire passage of the general storm area. Compared with the means for May of previous years the mean pressure for the present month agrees with the average or is slightly above, as indicated by the following table, which, in addition, shows the lowest pressure at the several stations on the days upon which the tornadoes occurred, exemplifying the extremely local influence of their devastating energy:

Stations.	Monthly mean.	Lowest reading on 29th and 30th.	Mean for many years.
	°	°	°
North Platte	29.47	29.16	29.454
Leavenworth	29.86	29.50	29.858
Dodge City	29.49	29.10	29.479
Omaha	29.81	29.32	29.823
Fort Gibson	29.91	29.50	29.878
Saint Louis	29.97	29.74	29.956
Keokuk	29.90	29.58	29.874

The remarkable and important feature of the general storm area from which the tornadoes developed was not a decided barometric depression, but a marked contrast of temperature. Their approach was not indicated by the rise and fall of the mercury in the barometer tube, but by the change in temperature and the direction and continuance over a considerable area of the prevailing northerly and southerly winds. Even within a few miles of the tornado's track, and from one to two hours before the storm appeared, no decided change in the barometer was noticed. This fact was reported to me by several persons who had simply consulted their instruments without making a record of the observation, but the incident seemed such a strange anomaly that the impression was not easily forgotten.

As shown by the Signal Service weather maps, there had been, since the morning of May 19, a continued movement of warm, moist air from the Gulf northward over the prairies of the Lower Missouri Valley, which fact corresponded very closely with the statements of many observers who remarked that they had had a strong and humid S. wind for from ten days to two weeks previous to the tornado's appearance. This current was not only experienced on the surface, but it prevailed in the upper regions of the atmosphere, as will be seen by the records of the Signal Service observer on the summit of Pike's Peak, who reported a continued SW. wind from the morning of the 5th to noon of the 11th, and from 4.35 p. m. of the 14th to 7.35 a. m. of the 29th. During the time the highest temperature of the month, 40°, was recorded at 2 and 4.35 p. m. of the 27th, and the lowest, 10°, at 7.35 a. m. of the 31st. Throughout the entire month in the Lower Missouri Valley there were only three or four intermissions of from twenty-four to thirty-six hours when the wind changed to another quarter. The prevailing direction for the month at all of the Signal Service stations (50) between the 88th and 107th meridians was southerly, with the exception of eight, and the entire region was from 1°.5 to 4°.5 above the mean of May for several ye rs..

All of the heavy storms of the month of May had passed across the country north of parallel 40°, becoming thereby the principal factor in the work of inducing this unusual movement of air to the north. Such a continued movement of the atmosphere in one direction had the effect of producing over the regions which it passed very marked changes in temperature and humidity. These warm southerly winds laden with moisture, crossed the land from the heated region o the Gulf, and passing northward constantly increased the temperature and humidity of the surrounding air, until, with the approach of cold NW. winds, the atmosphere over the Lower Missouri Valley was prepared not only to form unusually high contrasts of temperature but to present the prerequisites of excessive precipitation.

This comprehensible result is abundantly verified by the facts set forth in the accompanying weather maps and the following descriptions of the several tornadoes.

In order to avoid any confusion with reference to the location, which might result from so large a number of storms occurring on the same day, I have considered it advisable to designate each storm by some name that shall in a measure define its geographical position. The term so used does not in all cases mean that the storm actually passed over the spot from which the name is derived, but it is chosen with reference to its importance in defining the position of the storm's path

THE LEE SUMMIT TORNADO.

On the afternoon of May 30, the first developments of this storm were observed near the headwaters of Grand River, Missouri, a region of country lying between West Line, Cass County, Missouri, to the east, and Lonisburg, Miami County, Kansas, to the west.

At Paola, about 12 miles SW. of Lonisburg, no storm of any importance had occurred during the spring, or up to the 16th of June (the day of my visit there) except a very light thunder shower, unattended by hail or strong wind, about 3 p. m. of May 29. This storm of the 29th was much more severe farther westward, as will be seen from the weather reported at Osawatomie, about 7 miles SW. of Paola, where a heavy rain and hail storm came up from the SW. about 6 p. m. Before the storm the wind was very hot from the S. and SW., the prevailing direction for a week or two past; this storm was also felt at Somerset and Wichita, still farther west. The

Louisburg Herald of June 5 mentioned no storm on the afternoon of May 30, but referred to the light shower of the 29th. Several persons residing near Louisburg stated that there were threatening clouds to the E. and S. during the afternoon and evening, but culminating in no storm.

These facts relating to the atmospheric conditions west of Louisburg, and also to the S. and E., show that in all probability the tornado cloud formed to the eastward over the section of country previously designated. Its topography, as far as the eye could reach, was an alternation of high prairie and heavily wooded ravines, the latter generally trending E. and W. The timber appeared to be more dense and heavy and the ravines wider than in any other portion of the storm's track. The ravines were not bounded by precipitous banks, but gradually rose to the upland over bottoms varying from $\frac{1}{4}$ to $2\frac{1}{2}$ miles in width. The intervening hills, forming the rich prairie of the farmer and herder, ranged in height from 75 to 150 feet. Here was what might be called an excellent opportunity to study any connection that could exist between the origin of the funnel cloud and the formation of the earth's surface. If the irregularities here observed entered as an important factor into the disturbance necessary to destroy the equilibrium of the opposing warm and cold currents, and thereby form the funnel cloud, then at this point if at any in the storm's path should the cloud have descended and commenced its destruction. But the facts indicate no such operation, for the cloud was first seen at a considerable height above the earth, well defined against an almost clear sky (that is, for a short distance about it), apparently having formed and descended as the result of some violent commotion in the upper regions of the atmosphere. Maintaining this height of several hundred feet it moved at times slowly and then again more rapidly in a NE. direction over Dolan, Union, and West Peculiar townships, Cass County, Missouri, a distance of nearly 22 miles.

Mr. R. H. Abell, who lives $3\frac{3}{4}$ miles directly S. of West Line, stated that on the afternoon of May 30 (could not give the exact time, but thought about 6 p. m.) he saw two ominous-looking clouds in the NW. and SW.; the former appeared to be rising and moving forward but very slowly, while the latter moved much more rapidly toward it. Did not see the funnel cloud form, but noticed great commotion in the clouds near where the two currents appeared to have met, and judged that it must have originated there. He further stated that on the evening of the 29th it rained considerably, with a light fall of hail, wind NNW. quite strong. On the following morning the sky was partially clear until near noon, when it began to be overcast with dense haze, during the prevalence of a light southerly wind. About 3 p. m. heavy clouds commenced to bank up in the W., with a moderate wind from the SW.

Mr. J. W. Emerson, at Brosley, 7 miles due S. of West Line, stated that about 9 p. m. of the 29th it rained very hard, with a violent wind from the NW. During the day the wind had been mostly from the SE.

Mr. Emerson was at West Line on the 30th during the passage of the tornado, and stated that between 5 and 6 p. m. it commenced clouding up in the NW., with a brisk wind from the SW. There was a slight sprinkle, wind still in the SW. as the storm passed by. Nothing of importance was noticed except that it was very sultry.

Dr. E. L. Sands, druggist at West Line, $2\frac{1}{2}$ miles E. and $2\frac{3}{4}$ miles S. of the storm track, furnished me with the following data: During the afternoon of the 30th the air was very hot, thermometer suspended in the store back of the show-case and against the shelves registered 96°, wind S.; but as the clouds from the NW. and SW. approached each other the wind "whipped around" quickly to the SW. At about 6 p. m. saw dark clouds in the SW. and NW., with great commotion between them, and the funnel cloud, apparently resulting therefrom, moved from between the two to the NE. After it had passed the wind changed through the W. to the N. and the thermometer fell 20°.

During the cloud's progress over this portion of its path (above the ground), occasionally a tree was blown over, and now and then a few rods of rail fence, but no significance could be attached to the direction in which the objects were blown, or the amount of force represented in their destruction. The tornado had not yet commenced its characteristic work, although it was plainly seen by many parties situated several miles to the N. and S. of its path.

Mr. O. A. Hoag, jr., of West Union, Cass County, one mile E. and three-fourths of a mile S. of the storm's course, stated that between 5 and 6 p. m. he saw a funnel-shaped cloud to the NW. of him, and at a considerable height from the ground; did not notice any gyration or movement in the cloud, as his observation was made very quickly. Considerable rain and but very little hail fell immediately preceding its approach.

Mr. A. W. Hoag, sr., stated that about 6 p. m. he saw clouds coming from the NW. and SW., the latter moving the most rapidly. In a few moments thereafter, and while watching the sky, clouds began to rush together from the S., SW., NW., and N. with almost lightning rapidity. The lower current seemed to come from the S. and the upper current from the SW., the latter being the stronger. The heavy black cloud in the W. and NW. was the largest and blackest, and "sort of held back" or appeared to remain stationary until struck by the strong SW. current, when there resulted a terrible commotion in the surrounding clouds and great roaring like an approaching train of cars.

In a moment or so the funnel cloud made its appearance, looking like a large elephant's trunk with the small end pointing downward. Rain and hail fell in small quantities a few minutes before the funnel was formed, and appeared to be brought by the cloud from the SW. Neither Mr. Hoag nor his son saw the funnel cloud reach the ground, and are confident that it did not anywhere in their vicinity, as no destruction had been reported. This statement verified the results of my own observations, for in traveling down to West Line and beyond on one side of the storm's course and back on the other, I had failed to find or hear of any evidence of the existence of the tornado upon the earth's surface. Mr. Hoag, sr., further stated that before any distinctive features of the storm had appeared, the wind blew quite strong from due S., prostrating a small hickory tree near his house, and remained in that direction until the cloud from the SW. came up, when rain and hail followed, the wind veering to the SW., coming with a warm, quick rush like a puff of steam. It was soon over, and the wind blew from the N. much cooler. On the approach of the storm the thermometer stood 98°, but did not observe the fall when the wind changed to the N.

After leaving the vicinity of West Union the storm crossed Grand River in section 13, Union Township, and the NW. corner of West Peculiar Township, Cass County, first reaching the ground in the SE. corner of section 34, Raymore Township, Cass County, destroying the smoke-house of Mr. L. Shackelford, carrying the *débris* to the NE. This building stood a little W. of the storm's center, on an elevated strip of prairie called a "divide," running between Grand River and Major's Creek to the W. and another creek (name unknown) to the E.

Mrs. Irwin, who lives 3½ miles S. of Raymore, half a mile W. of Mr. Shackelford's, and three-quarters of a mile N. of the storm's track, stated that about 6 p. m. she saw a funnel-shaped cloud approaching from the SW. above the ground, but moving up and down with a "boiling motion." Could not see anything entering the cloud or flying about in it. The lower current was from the NW. and the upper current from the S. Hail like large "chunks of ice," with very little rain, fell just after the storm cloud passed. Saw the cloud when it dipped down at Mr. Shackelford's, rolling up cornstalks and dirt in a frightful manner.

Before advancing further with the course of the storm, I will give the reports of several persons who witnessed the cloud in this vicinity from Belton and Raymore, Cass County, the former 6½ miles and the latter 4 miles N. of the track. Both of these towns are on "high divides" from which the storm could be easily seen.

Rev. S. R. Reese, whose place of observation was one mile W. of Raymore and 4¾ miles N. of the storm's track, reports as follows:

"For several hours before the storm the wind blew hard from the SE. as the lower current, and carried no clouds. The upper current was from the SW., brisk, and carrying a thin sheet of clouds. At about 6 p. m. saw two rain clouds in the S. and W., the former traveling with the under current and the latter with the upper current in an easterly direction. In about half an hour these two clouds met at a point judged to be about 1½ miles NE. of Raymore. At their meeting the W. cloud became violently agitated at its western extremity (several parties stating that they saw a 'white cloud column' form at the agitated point and pass eastward); soon thereafter the tornado cloud was observed (diagram No. 1) passing a point 2 miles SE. of Raymore, its

course being about N., 20° E. Its form was that of a funnel, at times elongated into a serpentine-like form of heavy mold, hung up by the head and writhing in agony, its tail curling and lashing as if actuated by the impulses of a living body. (Diagram No. 2.) It was above the ground and doing no damage, though at times, in its violent contortions and struggles, it would descend very near to the ground. Its circular motion seemed to be from right to left. When last seen it rose high in the air and swept swiftly in a northerly direction into the apex of the two adjoining rain clouds which had preceded its appearance, and then disappeared."

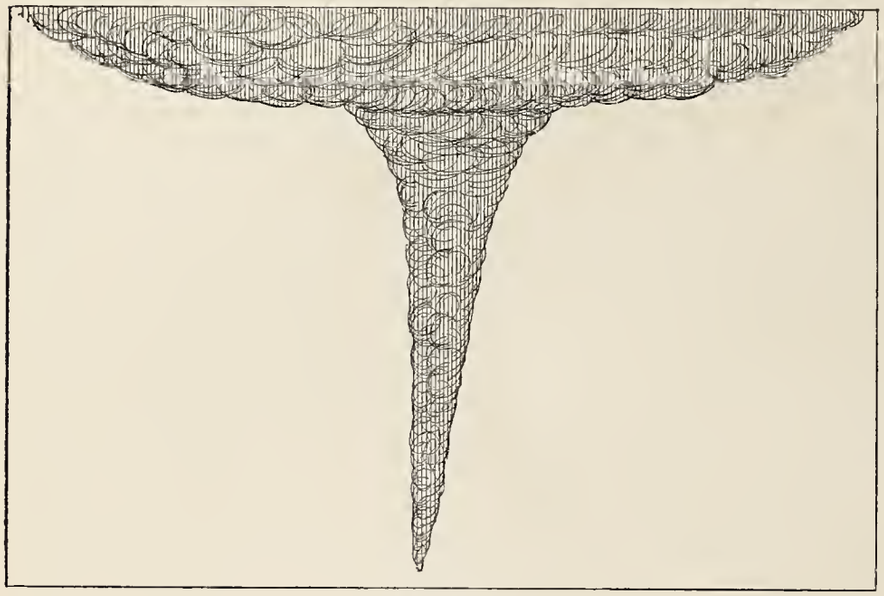


Diagram No. 1.

Mr. W. E. Wannamaker, stock and grain dealer at Raymore, was on the day of the storm 6 miles due E. of there, which locality placed him a little W. of the storm's track, stated that between 5 and 6 p. m. he experienced a heavy wind from the SE. with rain and hail.

Mr. James W. Harrison lives 4½ miles SE. of Belton and about 2½ miles N. of the storm's path; at about 5 p. m., as he was proceeding homeward, felt a strong SW. wind with rain and hail.

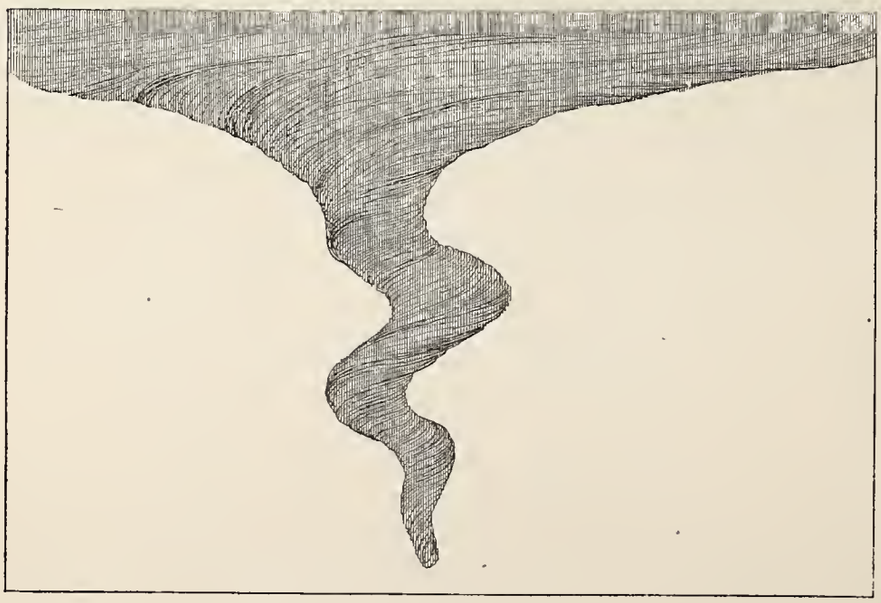


Diagram No. 2.

Mr. P. B. Hanna, postmaster at Raymore, stated that at about 6 p. m. the storm cloud, funnel-shaped in form, made its appearance to the SW. of the town, forming an angle of about 45° with the horizon; the lower portion seemed to be changed from a right line so that its position was inclined, the base being thrown forward in the direction in which the storm was moving. (Diagram No. 3.) During the afternoon and before the storm it had been exceedingly hot with a slight breeze from the SE. When the funnel cloud had approached a point nearly opposite him to the SE., and at a distance of about 2½ miles, he felt a momentary calm followed by a strong blast from the SW. When the funnel was first noticed, clouds were seen rushing from the NW. and SW. toward its base, moving inward and upward from right to left. The violence of the boiling motion in the vortex increased greatly as the blast from the SW. struck, causing the elastic column to sway off to the N., returning gradually again to its former course. A SW. wind was felt until the funnel had passed out of sight, when it changed to W. and NW.

Mr. W. S. Swisher lives 4½ miles SE. of Raymore and about 2 miles N. of the storm's path At about 6 p. m. felt a strong wind from the SW., accompanied by heavy rain, but no hail. Mr. J. O. Cheney, of Belton, stated that about 6 p. m., and before the tornado approached, it rained and hailed with very little wind, as the raindrops and hailstones seemed to come straight down. After the rain and hail stopped, wind came very strong from the SW., but no damage resulted. Noticed very dark-green colored clouds gathering in the SE., but did not see any funnel-shaped cloud.

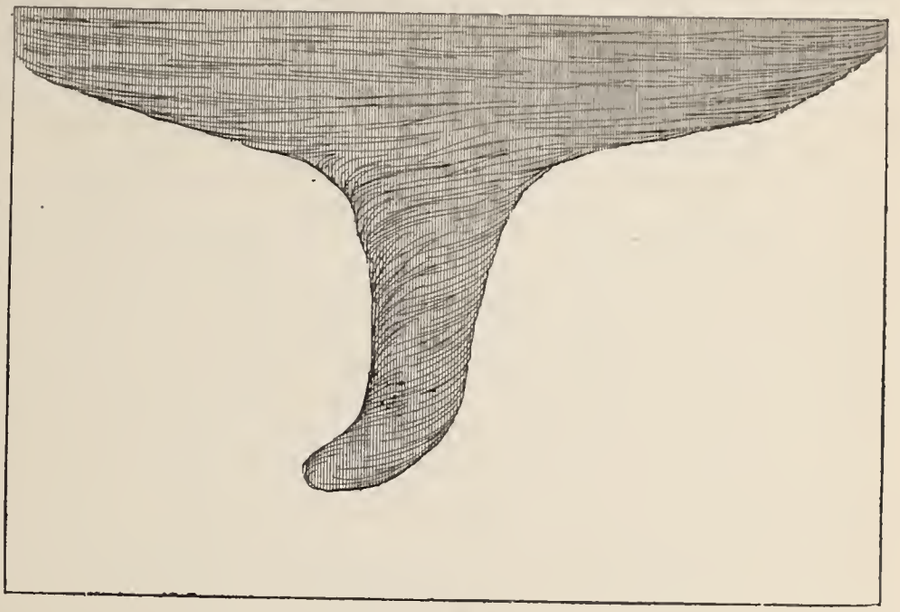


Diagram No. 3.

Mr. John Ingram lives 4¾ miles S. of Belton and about 2¾ miles N. of the storm's path. Was coming home from town and had reached a point about 3 miles due S. (time about 5 p. m.), when a severe storm of rain and hail, wind S., was experienced, lasting but a few minutes. After partially ceasing, several puffs of very hot wind struck his face coming from the WSW.

At Mr. Shaw's, 6½ miles SW. of Belton and 5¼ miles N. of the storm's path, considerable rain and hail fell, while the funnel-shaped cloud could be distinctly seen to the southward. It did not come down to the ground while passing. The elevation of Mr. Shaw's house is considerably above the surrounding country, as the funnel cloud could be seen at Blue Springs, a distance of 14 miles due NE.

Mr. John Bales, living in township 46 N., range 33 W., 4 miles S. of Belton, and about the same distance N. of the storm's path, stated that at about 5.30 p. m. he saw clouds having the appearance of smoke from a burning straw stack, moving from the SW. and SE. and boiling up in great commotion. They were moving very rapidly towards the NW., where a dense black cloud was rising, much heavier in form and indicative of rain, while the other clouds presented the characteristics of a heavy wind storm.

This noticeable difference in the character of the two clouds was quite well exemplified in what followed, as the hail and rain was considerably heavier between Mr. Bales's residence and the town of Belton to the N. and W. About ten minutes before the commotion in the clouds was witnessed rain and hail fell with a moderate N. wind. It was exceedingly sultry before the storm. Mr. Bales did not see the funnel, but his brother-in-law, Mr. R. M. Johnson, living one mile SE. of him, saw it plainly. The air immediately surrounding Mr Bales's house did not seem to be influenced by the passage of the storm-cloud. It was much cooler after the storm; yet the wind continued from the SW. During the passage a strong current of wind rushed down a little ravine running from W. to E. about one-quarter of a mile S. of the house. It was very violent, short and quick, tearing down several quite large trees.

Dr. R. M. Slaughter, of Belton, stated that at about 6 p. m. he saw clouds in the SE. and SW. moving toward each other, the former more rapidly. They formed a junction to the E. of Belton, when the funnel was seen to dart downward reaching, as he thought, to the ground; and this, in all probability was the case, for it was at a point a little SE. of Belton where Mr. Henderson's orchard was nearly destroyed. The funnel cloud about its edges possessed an indigo color, but in its center a greenish hue prevailed. It rose and fell and had a gyratory motion in a direction contrary to the hands of a watch. For the past five or six days the wind had been blowing from

the S. at from 25 to 30 miles per hour (estimated). About ten or fifteen minutes before the tornado approached rain and hail fell, the former quite heavily and the latter scattering, but large, rough, and sharp cornered. This precipitation did not change the temperature perceptibly. Just afterwards, and before the appearance of the tornado, a cool blast of air came from the NW., and in about three minutes from that time the funnel was observed to the eastward.

Mr. C. M. Williams, of Belton, stated that at about 6 p. m., when first watching the storm, he saw dark clouds approaching from the SE. and SW.; and when again making an observation, in the course of ten or fifteen minutes, saw that the two clouds had united near Dr. Dunnington's, about 15 miles NE. of Belton. The funnel cloud seemed to extend downward from the point where the two clouds joined and to reach the ground. Before it did so a great commotion was observed in the clouds and in the vortex, like the ebullitions of hot water. It would rise, fall, and careen from side to side like a balloon. The roaring was intense and could be heard a distance of about 17 miles. About fifteen minutes before the tornado was observed, rain and hail came from the SW. The latter was very large and peculiar in form, being covered with corn-shaped crystals on all sides. During the passage of the tornado no unusual wind was felt. On Thursday, the 29th, the wind blew very strong from the SW. all day and part of the night, but no rain fell, although thunder showers were witnessed in almost every direction.

Mr. T. J. Parris, hardware merchant at Belton, had a thermometer and barometer combined, forming what is called the "patent chemical barometer." On the approach of a storm the chemical precipitation in the bottom rises and permeates the clear liquid above to a considerable height, but during the passage of the tornado it remained undisturbed at the bottom, showing how narrow were the well-defined limits of the storm, and particularly the peculiar character of the disturbing forces. It seemed very strange and quite inexplicable to Mr. Parris, not understanding the peculiar nature of this class of storms.

Mr. J. B. Breckenridge, who lives upon about the highest point of land in Cass County, 2 miles SE. of Raymore, 1 mile N. and 2¼ miles W. of the storm's track, stated that between 5 and 6 p. m. he noticed to the E. of his house, and at a considerable height above the ground, a dark funnel-shaped cloud like a balloon moving slowly to the NE., and completely isolated from all surrounding masses of clouds. Did not watch it carefully, but noticed its queer shape, and particularly the fact that it seemed to be entirely by itself. During the time of its passage the wind was from the NW. and gentle. Did not experience anything oppressive in the atmosphere or consider it an unusual day in any respect, although it was quite warm. Previous to the 30th the wind had been southerly for several days, but changed to the NW. during the storm and remained so for two or three days, the weather in consequence becoming so cool that fires were required in the house, a remarkable occurrence for that time of the year. Mr. Breckenridge kindly furnished me with a series of thermometric observations taken before, during, and after the storm, at 3 p. m. of each day, from May 23 to June 4, inclusive. His instrument hung in the library, near the north window.

Date.	Hour.	Themometer.	Wind.
		°	
May 23	3 p. m	75	SE.
May 24	do	90	S.
May 25	do	88	S.
May 26	do	84	SW.
May 27	do	81	SW.
May 28	do	86	S.
May 29	do	88	SE.
May 30	do	78	NW.
May 31	do	76	WNW.
June 1	do	68	W.
June 2	do	71	NW.
June 3	do	84	WSW.
June 4	do	90	SW.

It is very interesting to note the marked change in the temperature on the afternoon of the 30th, about two hours before the tornado was seen to the eastward, when the thermometer read 10° lower than on the previous day. But taking into consideration the direction of the wind at the time, as well as the position of the house regarding elevation and the storm track, the explanation is not difficult.

Returning to the storm's track where we left it, at Mr. Shackelford's, we find that the funnel cloud remained but a few moments upon the surface of the ground. Rising about as quickly as it descended, it passed a distance of 3¼ miles at a height of several hundred feet, descending for the second time on the farm of Mr. Hamilton where it struck a shed covered with flax straw which it scattered all over a ten-acre field. It rose but a short distance above the ground after leaving this point, for it again descended about half a mile to the NE. at the house and orchard of Mr. Henderson. Mrs. Henderson kindly furnished me with the following information:

At about 6.30 p. m. the tornado struck the middle of the orchard at a distance of 145 feet W. of the house. Mr. Henderson, who stood out near the SW. corner of the house, saw the funnel shaped cloud about 80 rods distant coming up from the SW. It was boiling and twisting, and presented a frightful appearance. Watching it but for a moment, he turned about and walked into the house, going a distance of 35 feet, and had hardly made his entrance ere the cloud struck the orchard, and almost as quickly left it. I examined the ground and found that twelve trees were blown down; part were torn up by the roots and others simply bent to the ground. Not one of them was twisted, but all lay straight to the NE. with hardly a twig broken, showing that in all probability the base of the funnel did not really reach the ground, for, if it had, the circular action of the vortex would certainly have left some evidence of its force. The orchard had lately been trimmed, and small limbs lying upon the ground under the trees were, during the passage of the storm, picked up and violently forced into the S. side of a hedge fence just across the road from the orchard. The rail fence on the S. side of the road next to the orchard was blown over (not twisted) for a distance of 20 rods. The width of the damage in the orchard and of the rubbish in the hedge was exactly 100 feet in each case. The corn and oats to the S. and W. of the orchard were whipped to pieces, and looked as if dipped in muddy water. The width of the track where even the slightest damage was committed was 515 feet. The house stood 175 feet E. of the center of the storm's path, but was not injured, although the sensations of the inmates at the time of the storm were as if the building had been grasped by a monster hand and shaken severely. The ground about was swept as clean as if with a broom. Two hundred and seventy feet E. of the house the western half of a hay-covered stable was partly destroyed and the *débris* carried to the NE. The eastern half was still standing, and about as secure upon its foundation as before the storm. Thirty-three feet SE. of the stable lay a straw stack lightly thrown together, which did not appear as if touched by the wind. One hundred and twenty-nine feet E. of the house the hay roof of a hen-house was blown off and carried to the NE. No part of the destruction in this vicinity indicated the influence of any gyratory force.

Mrs. Henderson further stated that, as well as she could remember, the first blast upon the approach of the storm came from the SW., but not as severe as a similar current from the SW. when the funnel cloud passed through the orchard. It had been very sultry throughout the day, with a strong southerly wind, which had continued for nearly a week, accompanied by very little cloudiness until a few hours before the storm. Did not notice anything unusual in the atmosphere, or receive any premonition of the terrible storm, but it broke upon them in all its fury like a lightning's flash. From the time the cloud struck the orchard until it was seen passing over the fields some distance to the NE., did not consume thirty seconds. The family had hardly time to realize their situation when all was over and the air very quiet.

Mrs. Henderson was quite positive that she could distinguish a gyratory movement in the cloud contrary to the hands of a watch. It was boiling, twisting, and drawing itself up and down like a snake hung by its head and writhing in agony. The lower part of the funnel appeared to be about the size of a water bucket and the upper portion as large as the largest-sized wagon wheel. The outer portion was very black and looked like smoke issuing from a locomotive, while the inner part had a light milky appearance. It might be of importance to state that Mr. Hamilton's shed and Mr. Henderson's orchard stood upon slight eminences about 1 mile apart, with quite a well-defined valley between them, and the cloud in passing from one place to the other skipped the depression entirely.

The storm cloud next encountered some hay stacks (situated on high ground) on the property of Mr. John Robinson, one-fourth of a mile NNE. from Mr. Henderson's. They were scattered a

distance of about 80 rods along the storm's path, in a narrow strip averaging about 100 feet wide, but not thrown about promiscuously as if whirled. The stacks stood about 30 rods SE. of the house, which was not injured in the least. Ten rods NE. of the stacks several rods of fence were thrown over to the E., but not scattered.

From this point the funnel raised again, co nmitting no damage for a distance of $9\frac{3}{4}$ miles over an alternation of hill and dale, when it struck a large elm tree situated in a broad valley with gently sloping sides. The top of the tree was whipped into strings, but the base or trunk left uninjured. For a distance of 160 rods the storm passed up a gradual ascent to the NE., reaching the house of Dr. Dunnington, situated $1\frac{3}{4}$ miles SSE. of Lee's Summit. It was at this point that all reports from whatever source and of whatever character concerning the storm began their narrative and located the incipient stages of the tornado. It was about the nearest locality to the railroad of any manifestation of the storm's destructive force, and consequently the easiest attainable. The people in this vicinity were persistent in the belief that this was the starting point of the storm, until I assured them to the contrary after my explorations to the westward.

Dr. Dunnington stated, that about 6 p. m. (and in recalling the time said, that a moment or two before the storm, while reading at his desk, he had looked up at the clock and saw that it was exactly six) a severe rain and hail storm came upon them with a NW. wind which blew "desperately," smashing in the windows on the N. and W. sides and demolishing his office room, bottles, &c. As soon as possible after this occurred, the doctor, with his family, consisting of wife and grandchild, descended into the cellar. After the blast from the NW. a dark cloud was seen in the SW. moving up rapidly, and "it seemed as if the house was to be ground to pieces between the two clouds approacing each other." This supposition proved a reality, for the family had hardly reached the cellar ere the building was struck from the SW., throwing the N. end to the W. about 2 feet. The next instant the body of the house was lifted, pulling the studding out of the sills, and leaving the floor upon the foundation, which protected the family in the cellar. It was now completely twisted around from right to left and broken into kindling wood, the *débris* being scattered to the N., NW., and W., at distances ranging from 15 to 30 rods. The N. gable end was carried to the NE. 300 feet and apparently torn to pieces after striking the earth. The bed-clothing and clothes of the family were torn into shreds and looked, said the doctor, "as if some person, out of pure mischief, had carefully torn them into small strips.". The house was one story and a half high and 16 by 30 feet, with studding 12 feet and 2 inches long and 6 inches square. One hundred and eighty feet NNW. of the house stood a stable and corn-crib, which were swept from the ground, torn into pieces, and carried along the storm track to the NE. A hen-house weighing hardly 200 pounds and standing 126 feet W. of the house and 90 feet S. of the corn-crib, was not moved from its foundation or injured in the least. Some twenty-five or thirty trees were blown down about the residence, none of them twisted, however, but all lay out straight from the stump, pointing to the N. and NE. The width of the path of destruction was 180 yards. Seventy-five yards NE. of the house passes the track of the Missouri Pacific Railroad, on both sides of which, and for a distance of 180 rods, the board fence was blown down to the N. Twelve telegraph poles in the center of the storm's path were thrown in the same direction.

The roaring of the storm was so great that the family, while in the cellar, did not hear or know of the destruction that was going on above them, not realizing that the house had gone until they had emerged from their place of safety. The doctor was quite confident that he experienced a very strong smell of sulphur while in the cellar, yet those who were witnessing the passage of the tornado cloud were positive that no lightning issued from it. During the rain and hail from the NW., there were alternations of hot and cold puffs of air from the NW. and SW., the former at times almost suffocating; but after the cloud had passed a cold brisk wind set in from the W., veering to the NW., causing the family to shiver, the change in temperature being painfully evident. There was but a slight interval between the rain and hail, and the striking of the tornado cloud, say about five minutes, when precipitation entirely ceased. About half an hour before the storm passed, very dark clouds were noticed in the W. and a low rumbling noise heard, but up to 5.30 p. m. there was no rain. The darkness grew so rapidly after 5 p. m. that it became necessary to light a lamp at least an hour before the usual time. During the morning there was

an alternation of cloud and clear sky up to 10 a. m., when it commenced to grow threatening in the W., which condition continued very irregularly up to the culmination of the storm.

Several papers from Dr. Dunnington's were found at long distances from the house. A receipt for lumber, received from the firm of Childs & McClannahan, of Lee's Summit, was discovered at Knoxville, Ray County, across the Missouri, 40 miles to the NE. This paper was no doubt carried upward through the funnel cloud, and shot outward into a strong upper current from the SW.

The place of Daniel Cline, a tenant of Dr. Dunnington, and 40 rods NE. of the latter's house, was next visited. He stated that the tornado reached him about 6 p. m. The roaring was so loud and powerful that his wife felt certain that the eastward-bound mail train was approaching, and could not be convinced to the contrary until a careful observation was made revealing the truth. The house stood 25 rods west of the storm's center, and was moved bodily about 6 inches to the N., but not otherwise damaged. A stable containing five horses and a colt, and standing 50 feet NW. of the house, was turned over on its side to the NE., then torn to pieces and the *débris* scattered along the storm's track. The roof had not been found, nor any portion of it recognized, although search had been made along the track for several miles.

Before proceeding further with a detail of the destruction along the storm's track, it will be of importance to consider the testimony of several persons who witnessed the storm in this locality, from the town of Lee's Summit, 1½ miles W. of the storm center.

Mr. James A. Shaw, attorney-at-law, stated that at about 5.30 p. m., and before the funnel-shaped cloud made its appearance, rain and hail fell with a NW. wind. Shortly after, dark clouds commenced to bank up in the SW. and NW., and almost immediately thereafter a gust of warm air came from the SW. which appeared to encounter the clouds approaching from the NW., rolling them up and over each other in a very portentous manner, after which they seemed to move S. again, and at that moment the funnel was seen working down in a twisting manner from the overhanging clouds. At the moment the NW. clouds were driven backwards, the rain and hail, which was coming violently from the W., was also diverted so that it came from a southerly direction.

At this juncture Mr. J. B. Campbell, who was walking along the main street to the N., stated that his umbrella was converted into a parachute instanter, whereas just a moment before, the wind and rain had been beating against it, making it difficult to control.

Mr. O. H. Lewis, of Lee's Summit, whose house stands 1 mile W. of the storm's track, experienced the rain and hail as first coming from a southwesterly direction against his house, changing in about five minutes to the NW. almost instantly, when the hail commenced to strike the N. side of his house.

No damage of any kind was committed in the town during the passage of the storm. In fact, the air was quite still while the dark cloud was opposite to the SE. and E. The strongest wind experienced came with the hail from the NW.

It will be remembered that preceding the destruction at Dr. Dunnington's, a large elm tree was partially demolished in a valley SW. of the house. From this point it becomes necessary to follow the course of a second and much smaller funnel-shaped cloud that appears to have separated itself from the main cloud, nd traveled along the valley which runs a little S. of E. towards Greenwood, a small town on the west fork of Big Creek, 4 miles S. and 2 miles E. of Lee's Summit. Mr. William Thompson, whose new house stands 160 rods E. of the large elm tree, and 80 rods N. of the track of the small funnel, stated that he was watching the approach of the strange-looking cloud for some time before it reached the valley. It did not divide until it struck the elm tree, when a smaller funnel was discerned forming on the E. side of the large one, finally separating itself entirely, as the latter darted forward to the NE. The former then started down the valley back of his orchard, taking an ESE. course. Ten trees were blown over, and two chimneys were carried off from the house, all to the E.

Mr. Thompson's old house stands E. of the new one about 350 yards, and a half mile N. of the storm's track; it was not injured, except that a heavy platform lying on the ground W. of the kitchen was picked up and dashed through one of the windows in the E. front. A large granary, 12 by 32 feet, standing a few rods N. of the house, but on not as secure a foundation, was turned over to the E., not otherwise injuring it. About half way between the two houses (old and new)

stood a large railroad-crossing sign. The posts were 18 feet high, 12 inches square, and placed 3 feet in the ground, each post being supported by four braces, each 6 inches square, one end mortised into the post and the other placed in the ground. A heavy pine plank, 33 feet long, 2 inches thick, and 18 inches wide, connected the two posts at the top. The S. post was pulled out of the ground and away from the braces, leaving the other still upright and firm. The pine plank was split in two from end to end, and both it and the post were carried across the railroad track, a distance of 50 feet to the E.

Mr. Albert C. Millen, a carpenter who was working on Mr. Thompson's new house at the time of the storm, stated that at 6.05 p. m., by his watch, there was a strong wind from the NW., accompanied by rain and hail. By the time he had stepped out of the house to watch the storm the wind had changed to the SW., and felt very hot against his face. At the same time he noticed to the S. of W. a strange-looking cloud moving rapidly to the NE., having also a very violent motion, apparently from right to left upon its own axis. But one of these clouds was at first seen, and soon after another, similar in form but smaller, shot out from its side and passed eastward. In anticipation of a very hard wind storm, Mr. Miller ran SE. of the house several rods and grasped a small elm tree. He had hardly made himself secure ere he was enveloped in a thick, dark smoke, and whipped about the tree two or three times from right to left.

After leaving Mr. Thompson's, the small funnel passed down a short branch of the W. fork of Big Creek to the ESE., a distance of 1½ miles, without doing any damage, although a heavy wind was felt on both sides of its path. When it reached within about 300 feet of Greenwood cemetery, it left the creek (and, as some say, divided into two smaller funnels) and turned up a small ravine running to the NE., changing the course of the cloud about 80°. There was nothing of an abrupt nature in the configuration of the earth's surface at this point to influence the cloud in taking the new direction. It could have pursued the valley of the W. fork of Big Creek, down as far as Greenwood and beyond, without any apparent obstruction, so far at least, as topography was concerned. The banks on the W. and S. of the creek were quite high, and covered with a considerable growth of timber, but to the E. and in the course of the storm there were broad flats stretching out a distance of 80 rods or more.

Where the funnel turned to the NE. it passed around the base of a hill rising about 60 feet in a gentle slope to the northward. The cemetery to the SE. and on the opposite side of the storm's track was also on a slight rise of ground.

From all appearances the funnel seemed to be controlled by powerful forces in the atmosphere, emanating, perhaps, from the main funnel, only a short distance to the westward, or indirectly the effect of its disturbing influences, and not by any irregularities in the surface of the ground. The two traveled along side by side, the smaller one constantly approaching the larger, until it joined with it on the farm of John O. Howard, a distance of about 4 miles from the point where it turned to the NE. At no time was it distant from the main funnel more than 2 miles, and parties standing on the "divide" between them could see both distinctly.

Dr. J. L. Remsburg, who witnessed the storm from Greenwood, stated that at about 6 p. m. it rained and hailed with a SE. wind. After the rain and hail the wind veered to the SW. quite strong, and the small funnel cloud was seen reaching part way to the ground; at the same time an inverted funnel of dust and light materials formed over the earth beneath and reached up to it. (Diagram No. 4.) Both funnels had a gyratory motion from right to left, and were accompanied by a roaring noise like the rumbling of many trains of cars. No lightning was seen in either funnel cloud, yet during the rain and hail it was frequently observed.

About 30 rods N. of the cemetery, stood the house of Mrs. Kerr. She stated that a little after 6 p. m. saw two small funnels (Diagram No. 5) side by side, connected at the top, but separated at the bottom, passing up the ravine, the center of which lies 65 feet N. of the house. NW. of the house 12 rods, where the ravine crosses the N. and S. road, and on the W. side of the road, nine panels of board fence which connected a small portion of hedge on either side, were taken out without injuring the hedge. Across the road to the E., a distance of 40 feet, two panels were lifted above the rail fence, without throwing it down. Mrs. Kerr's house stood upon a rise of

ground about 30 feet above the ravine, but escaped all injury save a violent shaking which broke some of the windows. One hundred and fifty rods NE. of the house, and in the line of the storm, twelve panels of fence were destroyed, the posts being jerked out of the ground and several of them thrown to the N. on the E. side of the storm's track, but the majority back to the S. on the W. side of the track.

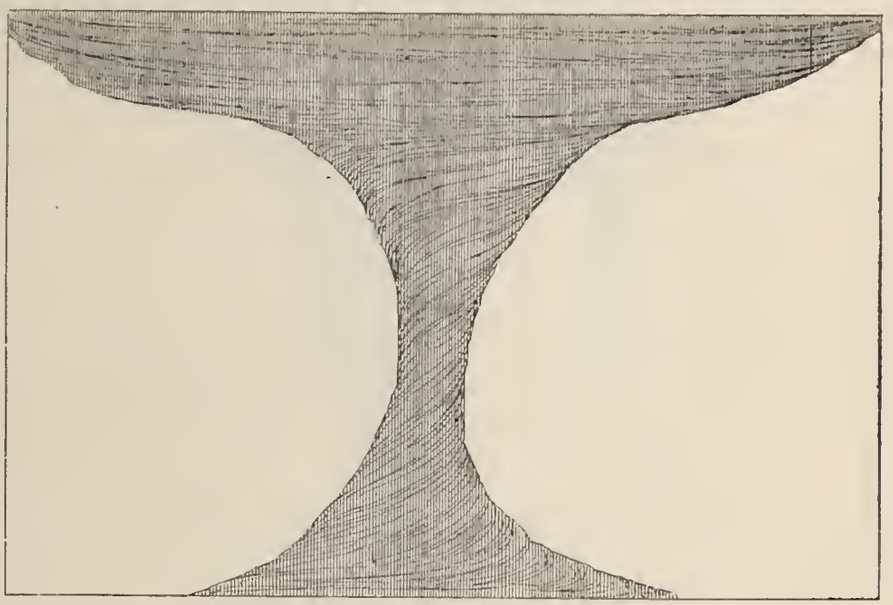


Diagram No. 4.

Mrs. L. Jones, who lives half a mile N. of Mrs. Kerr's, upon higher ground, and about 80 rods W. of the storm's track, and three-quarters of a mile E. of the track of the larger funnel, stated that she could see quite distinctly the latter while it was still SW. of Dr. Dunnington's; did not see it divide, as she was too much frightened to remain outside of the house and watch its progress. The house was shaken very violently, but could not tell positively the direction of the wind at the time. Thought that it must have come from the W., as everything lying loose about the building, such as chairs, boxes, barrels, &c., was carried out of the yard and across the road to the E. In the orchard to the S. of the house five trees were blown down to the E. and two to the W. Thirteen rods of fence W. of the house was all blown over to the E.

Mr. O. G. Bartley, who resides at Mr. J. C. Ransom's, nearly 1 mile NE. of Mrs. Kerr's, stated that about 6 p. m. saw two funnel-shaped clouds near Mrs. Kerr's house; they were passing up the ravine, and one of them seemed to be a little behind the other, and smaller than its companion. (Diagram No. 6.) Saw them enter the wheatfield NE. of the house, twisting and whipping the grain about, and filling it with black mud in places, from 6 to 20 feet wide. After leaving the wheat, the two clouds reunited into one, entering a cornfield and then a flaxfield half a mile E. of Mr. Ransom's house. Passing up a gentle ascent until it reached high ground, the cloud rose from the surface and bore away to the NNW. for one-fourth of a mile, when it again descended (still upon the high ground) in a small piece of flax, passing within 50 feet of a small shanty without harming it.

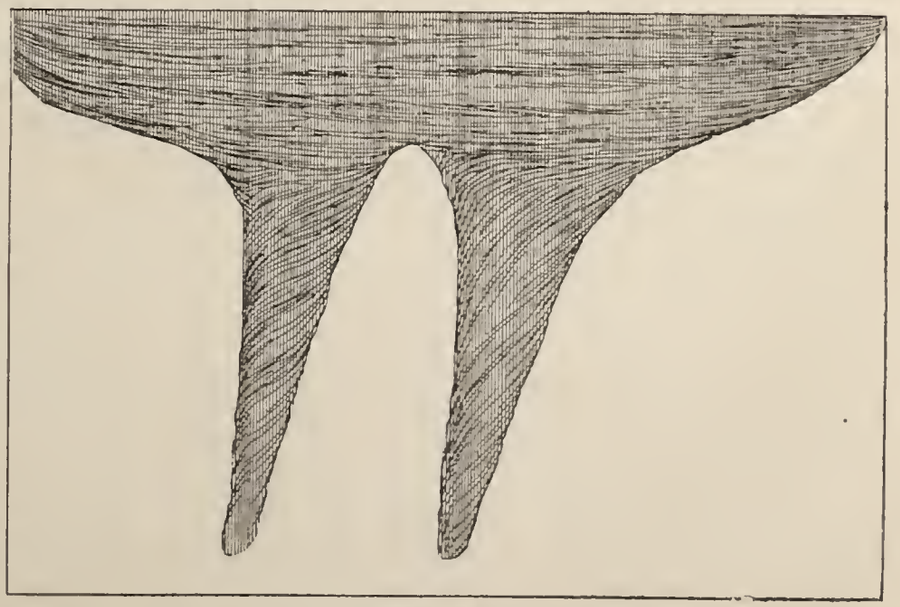


Diagram No. 5.

Mrs. B. H. Strother, who lives three-quarters of a mile NNW. of Mr. Ransom's, and 1 mile W.

of the storm's track, stated that she saw the dark funnel-shaped cloud come to the ground E. of the shanty, and then draw itself up into the clouds above. Mr. Stephen A. Lee, a neighbor, corroborated this statement.

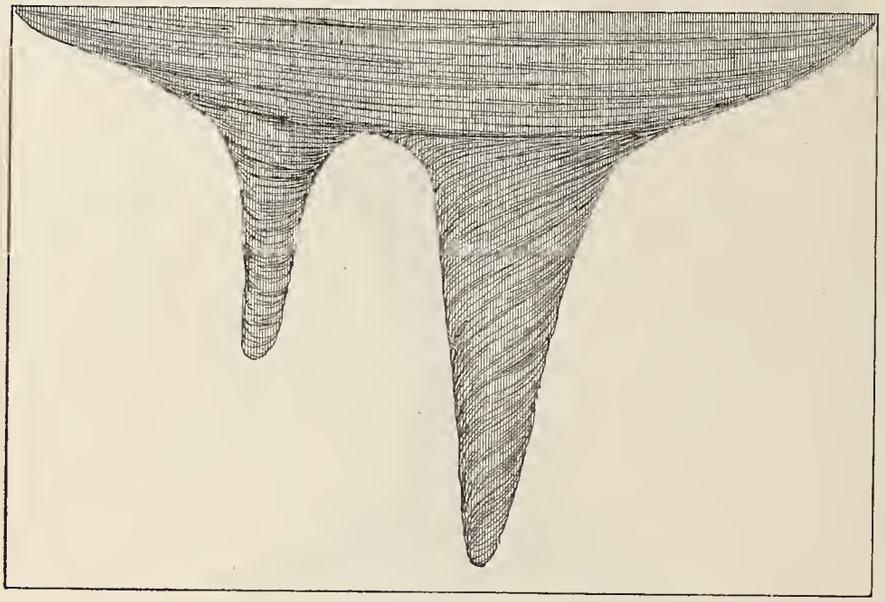


Diagram No. 6.

Three-fourths of a mile N. of Mrs. Strother's, 1 mile W. of the course of the small funnel, and about the same distance E. of the larger one, stood the house of Mr. J. B. Fields. Considerable fencing to the E. of the house was thrown down, some of it to the S. and N., but the largest portion to the E. One chimney was blown off to the E., but the house was not shaken much; the wind seemed to strike it only on the W. side.

Mr. Robert Daniel, a hired man of Mr. Fields, stated that about 6 p. m. saw the small funnel-shaped cloud about half a mile E. of the house passing in a northwesterly direction towards the larger funnel. It was at a considerable height from the ground, and seemed to be fast losing its identity in the surrounding clouds. Mr. Daniel did not see the junction of the two storm clouds, but had heard several persons mention the fact. I was not successful in finding any one who actually witnessed the contact, although I have no reason to doubt its occurrence.

Returning to the track of the larger funnel, where it had damaged the property of Mr. Cline, the tenant of Dr. Dunnington, we trace the storm to the house of Mr. John L. Van Meter, standing 75 rods E. of the storm's track. As the heavy wind struck the house, the clock stopped at 6.30 precisely. The building was one story and a half high, and 16 by 24 feet. On the approach of the storm the first heavy blast smashed in the S. door, and moved the whole house to the NW. a distance of 12 inches. Mr. Van Meter stated that he saw the dark cloud pass to the NE. west of his place of observation, and that afterwards the wind blew furiously from the SW. Did not see any lightning in the cloud, which was intensely black and seemed to fill the surrounding air with smoke. In the orchard to the SW. of the house (rows of trees running N. and S.), 15 or 20 trees were blown down to the NW., NNE., E., and NE. One hundred feet E. of the house stood the barn, 22 by 40, and 12 feet high, which was moved along on its foundation to the N., 4 feet.

About 15 minutes before the funnel-cloud appeared, rain and hail fell with a N. wind, which, after the precipitation had ceased, changed almost instantly to the S. and blew violently, followed by the passage of the dark cloud.

At Mr. Jonas Houghton's, one-fourth mile N. of Mr. Van Meter's, and 40 rods E. of the storm's track, a kitchen 10 by 12 feet attached to the E. end of the house was entirely demolished and the *débris* carried away to the N. In the front yard, W. of the house, several cottonwood trees were broken off at the height of 12 feet and the tops carried to the NE. In the orchard, 50 feet E. of the house, 45 trees were blown down with their tops pointing to the NE.; none of them were torn out by the roots. A grapery NW. of the orchard was badly damaged, the vines being torn from the trellises and both carried to the N. Mrs. Houghton stated that the funnel-shaped cloud as it passed was intensely black and greatly agitated. It moved with its lower portion or tail thrown forward, causing the cloud to appear inclined. (Diagram 7.) A young orchard 20 rods SE. of the old one was not harmed.

The house of Mr. Daniel Reeder, next in the course of the storm, stood W. of the track 40

31
29
6
32
28
5
33
8
4
34
9
3
35
N. Jones
10
2
Blue
Creek
15
11
1
T.R. Fields
C.H Young
R.G.W. Prewitt
F.M. Prewitt #2
J.G Riley
14
Underwood
Mrs. J.F. Farmer
John Laurence
23
J.P. Bridges
13
Church
24
J.G. Riley
18
Geo. Knox
19
Sny-a-Bar
O.P.M. Burdes
17
30
20
16
29
21
32
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22
33

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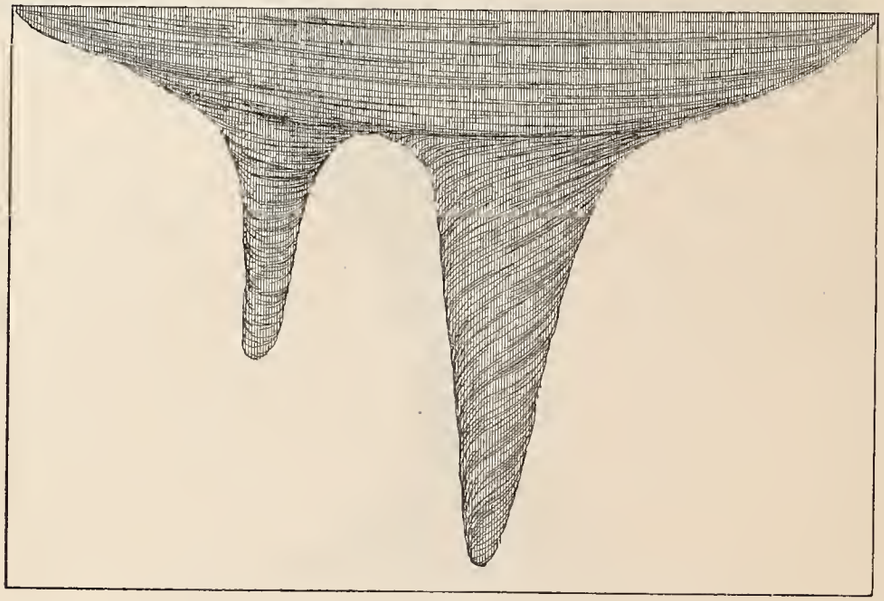

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The house of Mr. Daniel Reeder, next in the course of the storm, stood W. of the track 40

No XIII
STORM
TRACK
LEE'S SUMMIT
GREENWOOD
SMALL FUNNEL
RAYMORE
HARRISONVILLE
FREEMAN
Grand River
Big Creek
Middle Creek
Pleasant Run
Prairie Township
West Peculiar Township
Big Creek Township
Raymore Township
Harrison Township
Pleasant Township
Middle Creek Township
Grand River Township
Jackson Township
Johnson Township
Lee's Summit Township
Cemetery
Church
School
Mill
Depot
Bridge
Ford
Ferry
Mound
Quarry
Pond
Lake
Creek
Road
Railroad
Telegraph
Telephone
Section
Township
Range
Meridian
Boundary
Line
Fence
Orchard
Timber
Prairie
Swamp
Marsh
Spring
Well
Dwelling
Barn
Store
Post Office
Hotel
Blacksmith Shop
Saw Mill
Grist Mill
Tannery
Brick Yard
Coal Bank
Stone Quarry
Iron Bridge
Wood Bridge
Stone Bridge
Iron Fence
Wire Fence
Rail Fence
Hedge Fence
Board Fence
Stone Fence
Log Fence
Picket Fence
Ornamental Fence
Gate
Hitching Post
Trough
Windmill
Pump
Cistern
Flagpole
Monument
Grave
Tombstone
Fountain
Statue
Bench
Arbor
Trellis
Greenhouse
Conservatory
Summerhouse
Gazebo
Pergola
Bandstand
Kiosk
Pavilion
Tent
Flag
Banner
Pennant
Streamer
Balloon
Kite
Parachute
Airplane
Helicopter
Glider
Rocket
Missile
Satellite
Spacecraft
Astronaut
Alien
Extraterrestrial
Unidentified Flying Object
Ufo
Abduction
Crop Circle
Mutilation
Cattle
Horse
Sheep
Goat
Pig
Chicken
Dog
Cat
Rabbit
Deer
Bear
Wolf
Fox
Coyote
Bobcat
Mountain Lion
Eagle
Hawk
Owl
Crow
Raven
Vulture
Snake
Lizard
Turtle
Frog
Toad
Fish
Insect
Spider
Scorpion
Centipede
Millipede
Worm
Snail
Slug
Starfish
Jellyfish
Coral
Seaweed
Kelp
Algae
Fungus
Mushroom
Toadstool
Lichen
Moss
Fern
Cactus
Succulent
Tree
Shrub
Vine
Flower
Grass
Weed
Crop
Corn
Wheat
Oats
Barley
Rye
Soybeans
Alfalfa
Clover
Timothy
Hay
Silage
Manure
Fertilizer
Pesticide
Herbicide
Fungicide
Insecticide
Rodenticide
Seed
Planting
Harvesting
Threshing
Winnowing
Milling
Baking
Cooking
Eating
Drinking
Sleeping
Working
Playing
Reading
Writing
Drawing
Painting
Sculpting
Singing
Dancing
Acting
Directing
Producing
Editing
Publishing
Printing
Binding
Selling
Buying
Trading
Bartering
Stealing
Robbing
Killing
Dying
Burying
Mourning
Grieving
Celebrating
Praying
Worshiping
Believing
Doubting
Questioning
Searching
Finding
Losing
Forgetting
Remembering
Learning
Teaching
Studying
Testing
Grading
Graduating
Marrying
Divorcing
Adopting
Fostering
Parenting
Grandparenting
Great-grandparenting
Ancestor
Descendant
Sibling
Cousin
Aunt
Uncle
Niece
Nephew
Spouse
Child
Parent
Grandparent
Great-grandparent

rods. Upon examination I found that the building, 26 by 27 and 12 feet high, had been carried over the foundation to the SE. 14 feet 7 inches, and the SE. corner driven into the ground 2½ feet. Upon questioning Mrs. Reeder as to the effects of the storm at her house, she stated that the wind first struck the building from the NW., coming with the violence and quickness of a cannon-shot. It seemed as if something solid had been thrown against it. The NW. corner of the house was lifted from the ground and every particle of plastering knocked from the walls of the two W. rooms. About ten minutes before this strong blast it rained quite hard, accompanied by some hail. Mrs. Reeder and her daughter saw the storm while it was at Dr. Dunnington's, nearly 2 miles away. The latter was positive that she saw two funnels, the large one, and a smaller companion, a considerable distance to the E.; both were very dark on the outside, but lighter within. They were whirling continually, but could not tell the direction. Across the road from the house, to the W. 50 feet, not the least damage was done to anything. The house seemed to stand on the extreme western edge of the storm's path.

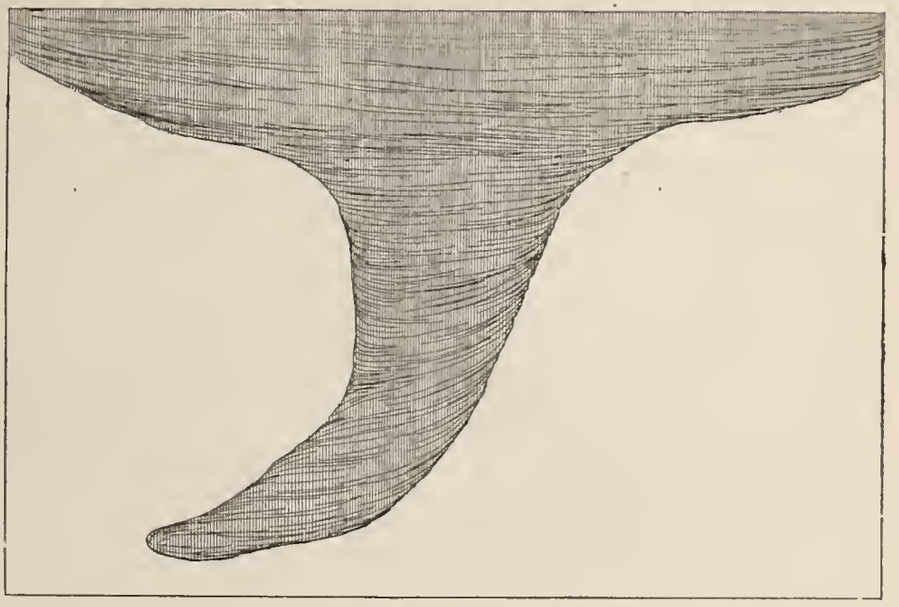


Diagram No. 7.

Among several of the peculiar manifestations of the wind's force at this place I relate the following: 150 feet NE. of the house and 10 feet W. of the stable, a large gate was carried 200 feet to the SE. and torn to pieces without injuring the stable. A heavy lumber wagon standing behind the corn-crib and at a distance of 155 feet E. of the house, was lifted up bodily and carried to the SE. over a cornfield a distance of 100 feet without injury. Two window panes were blown from a sash on the W. side of the house and carried inside without breaking them, while two out of the N. window were found broken. A large well curb lying E. of the house 15 feet was carried one-fourth mile to the SE. and lodged in a wheatfield. A heavy sulky cultivator, weighing about 600 pounds, was carried free from the ground a distance of 86 yards to the SSE. and broken by the fall. Another one standing near the corn-crib was partly carried and partly rolled, along a distance of about 60 rods to the SE., and then literally twisted to pieces and the *débris* scattered about over a field of 12 acres, apparently in circles. Mrs. Reeder and her daughter both stated positively that the time consumed in the destruction at their house did not exceed a half a minute.

One-half of a mile S. of Mr. Reeder's, and W. of the storm's track 250 yards, stood a corn-house, 16 by 24 feet and 12 feet high, nearly filled with corn. The building was torn to pieces and the grain scattered to the E., S., and NE. for distances varying from 75 to 100 feet. A large cooking-stove was carried out of the building 15 rods to the E. and badly broken. Surrounding the corn-house to the E. and S. was a large cornfield of 15 acres which was beaten flat to the ground, the stalks pointing in a NE. direction and covered with black mud. A fence made of oak posts and pine boards, running E. and W., to the N. and E. of the corn-house, was stripped of its boards, the nails remaining in the posts. Several of the latter were broken off at the ground. In this vicinity hedge fences running E. and W. were filled up with *débris* only on the S. side, while N. and S. fences were filled on both sides.

Mr. J. F. Goodman lives on the opposite side of the storm's track from Mr. Reeder's and 300 yards E. of its center. At about 5 o'clock p. m., as he states, a dark cloud was seen to rise in the NW., previous to which, during the day, the weather was fair and pleasant. As the cloud

approached, a light rain set in with a gentle SW. wind, when it began to grow darker, and in a few minutes hail came very fast and of large size. Just as the rain-cloud had arrived nearly over the house, a dark smoky-looking cloud was seen extending around the horizon from SE. to SW., and moving rapidly towards the NW. cloud. Before they met the hail and rain stopped, followed in a moment or two by a hard, misty rain with a cold brisk wind from the N. It then grew darker than ever, rained very hard for a moment or two, let up quickly, and as the mist cleared away, disclosed to the SW. about 2 miles, the two clouds in conjunction. By this time could not tell which way the wind was blowing, as everything in the atmosphere seemed to be converging to the point of meeting. Very soon after the clouds met, a dark funnel-shaped mass of vapor was seen depending from them near their point of meeting. The darkness was intense, and the roaring unlike anything ever before heard. Although the cloud was nearly a mile away, members of the family could not hear each other speak, as they rushed to and fro about the house, shutting and barring doors and windows. They had hardly finished when the storm was upon them, and almost as quick as thought the shock was over. The house was struck by the wind at the SW. corner, the current seeming to divide, a portion passing on either side and then coming together, giving the house a severe shock from the NE. The S. side of the house was bent inward considerably, and a window sash blown in, plastering was knocked off in many places, and the studding on the W. end was loosened from the sills. A smoke-house 20 feet E. of the house, size 12 by 14 feet, containing 1,000 pounds of bacon and about 400 pounds of lard, salt, &c., was all blown away to the NE., except the floor and a portion of the bacon, which seemed to hold it down. A large barn 50 yards NE. of the house, size 30 by 36 feet, 16 feet high, with sheds on the N. and S. sides, was moved on the foundation to the N., the W. end 12 inches and the E. end 7 inches. The NW. corner of the barn was entirely carried away. Several trees in the orchard were carried to the E. and NE.

Upon examining the center of the storm's track in the fields to the W. of the house shortly after the passage of the tornado, Mr. Goodman stated that it looked as if a violently rushing stream of water had passed over the surface having a width of from 50 to 100 feet. He also observed that the center of the storm could be easily distinguished wherever there was destruction, as all *débris* on the W. side was carried inwards toward the track, on the E. side parallel with it, and in the center in every direction.

Mr. W. E. Thorpe, about 50 rods SE. of Mr. Goodman's, and E. of the storm's track, first felt the wind from the N. as the storm approached, and in a few moments it shifted instantly to the SW., shaking the house severely, and prostrating 40 trees in the orchard, laying them to the NE. without a single exception.

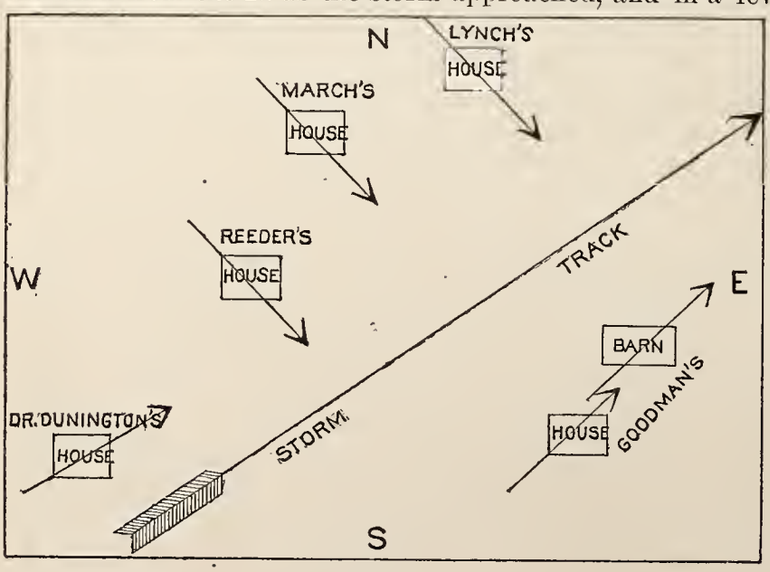


Diagram No. 8.

Mr. Bartly Jones, one-fourth of a mile E. of Mr. Thorpe's, and nearly 1 mile E. of the storm's center, did not experience as strong a wind from the SW. One tree was blown down, and a barn 60 feet SE. of the house was first moved to the S. 4 feet, and then back again to the N.; all done very quickly.

Mr. J. L. March, W. of the storm's center about 40 rods, and a little N. of Mr. Reeder's, had 15 or 20 trees blown down in his orchard to the SE. As the storm passed the wind changed to the N. and grew colder. Mr. Thomas J. Lynch, adjoining Mr. March, but a little nearer the storm's center, had trees and fences blown to the SE. (Diagram No. 8.)

Mr. Theo. Tennison, due E. of Mr. Goodman's one-fourth of a mile, half a mile E. of the

larger storm cloud, and 1¼ miles W. of the smaller, had 20 trees blown down in his orchard to the E., and half a mile of rail fence carried in the same direction. During the first part of the day the weather had been very pleasant, but inclined to be sultry, wind principally from the SE., which had been the prevailing direction for several days. No clouds were to be seen up to 3 p. m., but an hour later a few began to appear along the western horizon. At 4.30 p. m. two very dark clouds rose quickly above the horizon, one in the NW. and the other in the SW., followed in a few moments by rain and hail with a cold NW. wind. Did not see the small funnel cloud to the E., but could distinctly discern the large one, and after it passed, a current of air came from the SW., not as strong as the one that did the destruction, but so hot as to almost prevent respiration.

Mr. C. D. Martin lives NW. of Mr. Tennison and 150 yards E. of the storm's center. He stated that about 6 p. m. saw a dark funnel-shaped cloud coming up from the SW. By the time it had reached a point nearly opposite his house the darkness became so intense that he could not see 10 feet away from him, and the roaring was so great that, standing with his wife in the kitchen holding the door, they could not hear the screaming of their daughter for assistance in an adjoining room, even though the door between the two rooms was open. The strongest wind was felt from the southwest, and during the passage of the tornado no other current was experienced, although previously the rain and hail came with a NW. wind. While the tornado was passing, the house seemed to rise and fall very gently five or six times. Mr. Martin had hardly reached the doors and windows to hold them before the storm was over. Although the house was not moved from its foundation, a larger and stronger building standing 8 feet to the NE., consisting of a smoke-house and granary 12 by 21 and 12 feet high, was lifted from its foundation and carried, the SE. corner 8 feet to the NE. and 4 feet E., and the NW. corner 9 feet to the NE. and 20 feet E. Thirteen trees in the orchard N. of the house were blown down to the E. and NE. NW. of the house about 140 rods, the funnel cloud struck the ground in a cornfield, scooping out a hole 3 feet deep and 5½ feet long. I did not see the excavation, as the field had been recultivated, but Mr. Martin and his son positively affirmed its existence and the cause as assigned. The cloud was very dark on the outside but lighter through its center. As it drew nearer *débris* of all kinds was seen flying about in the central portions of the cloud, and many light objects were drawn into the vortex from all sides and then upward through it, being shot out from the top in many directions. Several persons in this vicinity stated to me that at points outside of the path of destructive winds, and at distances varying from 1 to 2½ miles, leaves, papers, and pieces of timber fell straight to the ground, and was in some cases the first intimation to them that any severe storm was in progress.

Moving onward in the course of the storm, we next visit Mr. Alva A. Drake, tenant upon the farm of Mr. McMillan. House stood 60 rods W. of the storm's center. The wind struck it square from the SW. shaking it severely but causing no particular damage. The current of air then whirled around the building to the W. and S., carrying small apple trees and loose articles in a circle to the S. and E. An out-house was turned over to the S., and a lumber wagon backed in the same direction a distance of 40 feet.

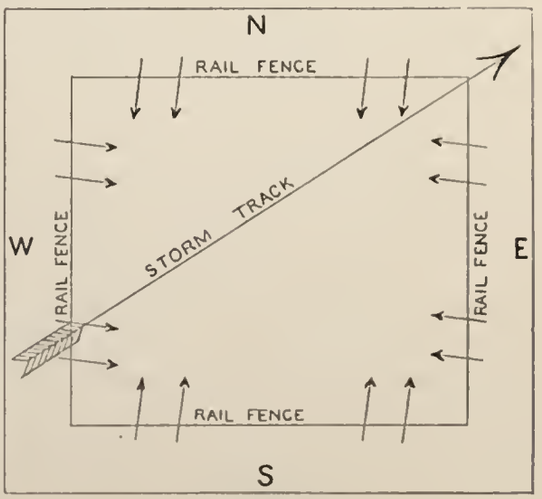


Diagram No. 9.

Mr. George Wigington, who lives WSW. of Mr. Drake's half a mile, did not know that any unusual storm had passed until the next morning, when he was notified by Mr. Drake. Mr. E. Smart, one-fourth mile WNW. of Mr. Drake's, did not feel the storm; the atmosphere was very quiet about his house. Mr. John Litzsinger lived due E. of Mr. Drake's 40 rods and within about 20 rods of the storm's center; his house, 14 by 24 feet and 7 feet posts, had the north end carried to the west 12 feet, while the south end was moved only 15 inches.

Mr. John T. Lacy lived N. of Mr. Drake's, and 80 rods W. of the storm's center; house was

not damaged; first felt a strong wind from the SW. and then from the N. during the passage of the cloud. SE. of the house, and in the center of the track, a rail fence surrounding a piece of land 40 rods square was thrown down inward toward the center on all sides. (Diagram No. 9.) The fence was put up when I arrived upon the ground, but Mr. Lacy, and also one of his neighbors, assured me that the facts were just as stated. A tenant house belonging to Mr. Robert Watson, and situated one-fourth mile SE. of Mr. Lacy's, and W. of the storm's center 50 yards, was damaged severely. The building stood N. and S., was 20 by 30 feet long and 8 feet high. It was first moved to the W. 30 feet, then turned around by the N., so that the length of the building stood E. and W., and then moved 70 feet to the E., where it was left standing right side up, but badly twisted. In these movements it must have been above the ground nearly all the time, as where it touched it only scratched the surface slightly. Two stacks of rye straw (in bundles), standing side by side 40 feet north of the house, were mingled together in the most indiscriminate manner; even the bundles were in some instances found twisted into each other. They were carried to the NW., W., SW., and by the S. to the NE. A barn, 16 by 20 feet and 10 feet posts, standing 20 feet E. of the stacks, was completely demolished, and the *débris* carried to the NW., W., SW., and NE. In an orchard of small trees, 40 feet N. of the stacks, only two of them were broken off, and lay pointing to the E.

Mr. John C. Howard's residence, E. of the storm's center about one-quarter of a mile, and standing upon a considerable rise of ground directly E. of Mr. Watson's tenant house, was damaged but slightly. It is one of the largest houses in the vicinity, and very strongly built. Three chimneys were blown off, and during the prevalence of the violent SW. current it was shaken so severely that the inmates expected it to be torn to pieces. In the orchard just N. of the house, 110 trees were blown to the NE. A large straw stack, 200 yards NW. of the house, was scattered along the track for a mile or more. Sixty rods of E. and W. fence, 250 yards W. of the house, was blown down to the E.

Mr. John Espy, three-quarters of a mile SE. of Mr. Howard's, and over a mile E. of the storm's center, felt a very strong wind from the SW. during the storm, which shook his house quite severely, and blew down several trees in his yard.

One of the most completely demolished houses throughout the entire path of the storm was that of Mr. R. Quissenberry. It stood a little E. of the storm's center, perhaps 30 feet, upon quite high ground, and just across the road N. of Mr. Howard's. Unfortunately I failed to see Mr. Quissenberry to question him concerning the storm, but, instead, obtained a very fair statement from his nephew, Mr. T. O. Evans, who occupied a portion of the house when it was destroyed. During the afternoon Mr. Evans was cultivating corn E. of the house (the cornfield surrounded the dwelling), and at 6 p. m. was called to stop and come in. On going "a round or two more" he did as requested, and "put out" his horses. It was then 6.30 p. m. and rain was falling gently; had not rained before during the day. Went inside the house, sat down near a window in the south end and began reading, but was almost immediately interrupted by a strange and unusually loud roaring noise outside, as if a train of cars was coming very near and at a terrible rate of speed. In about five minutes, and while considering from what source the noise could arise, a violent gust of wind, coming like a cannon shot, struck the SW. corner of the house, moving it to the W. a little, and then in an instant everything went to pieces, but could not tell how. Mr. Evans was thrown to the SW. about 30 yards. After striking the ground he was lifted up and down, nearly in the same locality, two or three times, but each time very gently. After the storm passed, which was not more than fifteen or twenty seconds, he found, upon examination, that his hair was completely matted, and his eyes and ears filled with black mud. There were five children and three grown persons in the house at the time of its destruction. One boy was thrown to the NW. 90 feet and cut severely upon the head and nose. His clothing was filled with black mud, it being fairly driven into the texture, and his eyes, ears, and hair suffered a similar fate. Another child was carried to the NE. 20 yards and completely bedaubed with mud, which latter condition was the case with the entire family. Three of the children who were in the same room with Mr. Evans and his uncle were covered up in the rubbish near the foundation; the latter being carried 65 feet to the NW. and considerably bruised. Mrs. Quissenberry was knocked senseless at the

commencement of the storm by the east kitchen door blowing open against her. She was cut badly in several places and found lying in the field 20 feet N. of the house. The dimensions of the building were as follows: 20 by 36 feet, one and one-half stories high, standing N. and S., with a kitchen on the north end 18 by 20 feet and one story high. The W. side of the house was thrown outward and remained upon the ground near the foundation, its S. end whirled around to the NW. in a half circle, a distance of 66 feet. The remainder of the house was scattered over 15 or 20 acres and in a general direction to the NE.

In the edge of the cornfield, just W. of the house, and for a width of 20 to 30 feet, the loose earth had been beaten down by the violence of the wind so hard that it could not be easily worked up with a gardening tool. To the distance of 180 feet W. of the house, the corn was beaten into the ground in such a manner as to convey the impression that this portion of the field had been mowed, while 25 feet to the E. of the house the stalks were hardly bent over. The barn standing N. of the house, 30 feet, was torn to pieces and scattered to the NE. Three horses were in the stable at the time, but all escaped without much injury except one, which, from all appearances, ran directly into the storm's path, where it was picked up and carried or rather shoved along for a distance of 80 feet. The course taken and the length of the path was indicated by the holes cut into the ground where the animal tried to brace itself with its fore feet. A sulky cultivator, standing 10 feet N. of the barn and 30 feet W. of the storm's center was not moved or injured. A lumber wagon standing a few feet SE. of the cultivator was broken in two, the forward part carried 50 feet to the NE. and stopped by the tongue running into the ground. The hinder part was wheeled along by the force of the wind, which fact was shown by the tracks through a hollow, up and over a ridge to the NE., and through a board fence, a distance of 90 rods. On this ridge, over which the center of the storm passed, the board fence was torn down for a width of 50 rods. Attached to loose boards, naked posts, limbs of trees, and lying upon the ground were fragments of clothing, bed-quilts, sheets, and mattresses scattered along for a distance of 1½ miles NE. of the house. Every article was filled with mud, which, to all appearances, must have been blown into them with great violence. A dog was carried NE. of the house 200 yards and killed, his head and shoulders being driven into the ground. A large sheet-iron stove standing about the center of the house was carried 25 yards to the N., and completely torn to pieces. A small board step, weighing hardly 10 pounds, and lying 3 feet W. of the SE. corner of the house, was not moved from its position during the storm. A large wooden beam plow, with whippletrees attached, and standing near the barn, was carried 30 feet to the NE., and the handles broken off. A sewing-machine standing in the S. end of the house before the storm, was found scattered in small pieces about the ruins, the largest portion being found 30 yards to the N., in the cornfield.

At the house of Mr. James Duckworth, 30 rods E. of Mr. Quissenberry's, the N. gable end was shattered and the portico blown away. A barn, 30 by 40 feet, standing NE. of the house 20 rods, was entirely swept away, even to the foundation. An out-house, NW. of the house 40 feet, was carried away, but a corn-crib N. of the house 30 feet and a hen-house, ENE. 12 feet, had only their roofs slightly injured.

The next house visited by the storm was that of Mr. J. A. Scruggs, about 1¼ miles NE. of Mr. Quissenberry's, and standing 60 rods E. of the central portion of the storm's path, on a side-hill near the bottom of a ravine. About ten minutes before the tornado passed it rained and hailed considerably, ceasing very suddenly as the storm cloud came up. The family were seated at supper—about 7 p. m. Mrs. Scruggs stepped out while it was still raining, to protect some of her young chickens, and had barely succeeded in securing them, as best she could, when the storm cloud reached her, the wind blowing so furiously that she could not get back to the house, although only 15 feet distant. In this condition she caught hold of a small tree near by, around which she was blown several times in quick succession, breaking her collar bone and otherwise injuring her. The S. half of the roof was torn off without moving the house on its foundation, and the *débris* carried to the NE. Twenty-five feet NE. of the house a granary was demolished and the *débris* carried to the NE. A hen-house 35 feet ENE. of the house was destroyed and carried to the E. In the orchard, to the SE. of the house, 18 trees were blown down with their tops pointing, some to the E. and others to the NE. Several other out-buildings, consisting of

barns and sheds, were unroofed or torn down to the foundation, and the *débris* carried to the E. and NE. A heavy lumber-wagon box was carried across the ravine E. of the house and landed upon a high piece of ground, a distance of 100 rods. Two of the wagon-wheels were carried into the ravine, a distance of 30 rods, and the remainder of the wagon was distributed along the track in small pieces. There were two colts and two horses pasturing in the ravine about where the center of the storm passed. After the storm they were not found until the next morning, when it was discovered, in following their trail, that at times they had been lifted from the ground and then dashed down again, their feet plowing up the surface every few rods. They were driven over several rail fences and straight through one thick hedge. In their course they had passed out of the open ravine, through a cornfield, over a ridge, and into a wooded ravine beyond. The colts were badly crippled, the horses receiving but a few scratches.

Mr. Thomas Winburn, one-fourth mile N. of Mr. Scruggs's, but farther W. of the storm's center, had a few small trees blown down near his house, but no further injury was committed.

Mr. John Jones, one-fourth mile W. of Scruggs's, and 130 rods W. of the storm's center, did not feel the effects of the storm or know of its destruction until the next morning. It rained quite hard, but without a strong wind; heard roaring, but thought it was the water running into the cistern.

Mr. George Bennett and Mr. James W. Dunn, near neighbors of Mr. Jones, did not experience any strong wind during the passage of the storm.

Again, evidence is presented of the relative width of the E. and W. sides of the storm track. On the E. side, at this point, fences and scattering trees were blown down for a width of 1½ miles, while on the W. side such destruction did not extend 80 rods. In fact, at many places on the W. side not even a brisk wind was felt at that distance, while on the E. side strong winds were experienced at a distance of from 2 to 3 miles.

Since leaving Dr. Dunnington's, which was upon a slight rise of ground sloping to the N. and S., the storm has pursued a course nearly due NE. and confined its destruction within the bounds of a considerable depression (not quite a ravine) in the rolling surface of the prairie. It did not follow all of its windings, but crossed, alternately, projecting points of high land and intervening dales; in other words, the storm kept to its characteristic NE. course, whatever the surface. After leaving Mr. Scruggs's it bore a little more to the E., apparently purposing to avoid the ravine, which, from this locality, grew deeper, with precipitous sides, as it advanced to the northward. Here was encountered the deepest ravine in the course of the storm, its sides and bottom lined with heavy timber, offering no obstruction at its entrance and right in the line of the storm, had the funnel bore to the N. instead of to the NNE. In bearing to the E. the funnel passed over a projecting point of high land and then down into a short branch of the large ravine, which ran 550 yards to the ENE. This branch was at least 400 feet wide, and its eastern bank presented an almost perpendicular height of between 70 and 80 feet. The cloud, instead of dipping down into this cañon, as it were, seemed to pass over it, almost above the highest tree tops, as they were found broken off through the bottom and along the eastern bank at heights ranging from 15 to 50 feet. Many of the trees had just the upper limbs twisted off, and in this respect the circular action of the cloud was most graphically displayed. Small limbs of the oak and hickory were in many cases twisted several times about adjoining limbs or the body of the tree and invariably in a direction from right to left. Along the upper edge of the eastern bank green hickories, of from 1 to 2 feet in diameter, were twisted off near the base. Along the eastern side of the storm's path, on the high ground above the ravine, narrow paths or swathes were cut into the timber from the SW., viz, a group of trees twisted or broken off, alternating with a strip of ground several rods wide (sometimes a quarter of a mile), apparently unharmed. This peculiar effect of the SW. air current could be observed wherever the timber was wide enough, and also, I was told, in the fences after the same manner. The cloud did not follow the course of the short ravine at all, but cut across it in the direct line of its course, rising over a ridge about 100 feet high, and passing through an open field to the house of Mr. Samuel Constable, tenant on the farm of Mr. Blackwell. It was a log house standing upon a ridge of land one-fourth of a mile NE. of the ravine and about 60 feet W. of the storm's center. Where the tornado crossed the road below the house, the rail

fence on both sides, for a distance of 30 rods, was completely bedaubed with mud and weeds, each rail looking as if taken from the bottom of a muddy stream. The width of the path of greatest destruction at this place was 580 feet, it widening out in every instance as it entered the timber. The house was thrown into a mass of ruins, logs scattered about promiscuously, and portions of the roof lodged in the woods 25 rods NE. of the house. Clothing and bedding, torn into strips, were found hanging in the tops of the trees. A log barn 18 rods W. of the house, was torn down, but not as badly as the latter.

In the timber to the N. and W. of Mr. Constable's, for a distance of 60 to 80 rods, large oak trees, 2 and 3 feet in diameter, were broken square off near the ground, or terribly shattered by a violent twisting force. Their tops lay pointing to the NW., W., E., and S. A very tough green white-oak tree, 18 inches in diameter, standing near the storm's center, was bent over to the NW. about 2½ feet above the ground, and twisted once around from right to left, but the fibers of the wood were so tough and flexible that they still held the trunk to the stump.

Mr. Constable, who sat upon the fence, just S. of the house watching the approach of the ominous looking cloud, did not move from his place of observation, thinking that the cloud would certainly pass him without injury, it being so narrow; but before being at all aware of his perilous position, he was caught up by the whirling current of air and carried across the road into a pasture, a distance of about 80 feet, where he afterwards found himself covered with mud from head to foot, clothes torn, and badly frightened, but a wiser man.

From this locality, for a distance of 1¼ miles to the NE., the track of the storm lay through a belt of heavy timber, bordering upon and thickly lining a large ravine to the W. of the storm's path. The path of greatest destruction widened out here to its utmost, varying from 800 to 1,200 feet, and at Mr. Hutchins's, the next place visited, its width was about 90 rods. This place and vicinity was the scene of the greatest manifestation of the tornado's power, throughout its course. In its path through the timber, trees on the W. side were thrown to the N., NW., W., SW., and S., while on the E. side they were thrown to the E., NE., and N. At the center they lay parallel with the storm's course, and also across it, with their tops sometimes to the E. and quite as often to the W. I examined twenty-one cases where trees had been twisted and found without an exception that the direction was from right to left. Before reaching Mr. Hutchins's, the tornado demolished a school-house, situated at the edge of the timber, about 20 rods E. of the storm's center, and on a considerable elevation, the ground sloping to the SE., S., and SW.

The storm at this point bore considerably to the N., and just as it changed its course the school-house was taken, in all probability, by an inrushing current from the SW. Its size was 18 by 33 feet and one story high. The building was first lifted bodily, moved 16 feet due N., and then all above the floor was carried away to the NE., the S. side dropping to the ground after passing 2½ feet beyond the foundation. There were two rows of desks running E. and W., six in each row. In the S. row two were left on the W. end, and in the N. row five were left, showing that the greatest force of the impinging current struck the SW. corner of the house and lifted the body of the building clear from the desks on the W. end, but on the opposite end the desks were entirely carried away. The N. side, together with both ends and the roof, were literally torn to pieces, and portions carried to the E., NE., and NW. The stove remained in the center of the floor, but the drum and pipe were carried away.

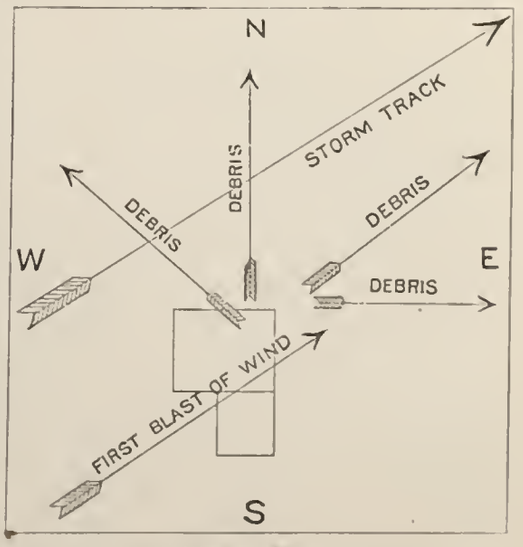


Diagram No. 10.

The storm from this point made frightful havoc in the heavy oak and hickory timber, as it moved up the hill towards Mr. Hutchins's, one fourth of a mile to the NNE. Here, as I said before, the storm was remarkably severe. The house stood upon a considerable elevation, about 200 feet E. of the storm's center, with the ground sloping to the S., W., and NW. into a heavily wooded ravine,

a continuation of the one commencing near Mr. Scruggs's. To the NE., E., and SE. lay a broad stretch of highly cultivated prairie with a gently rolling surface. The house was a new building and very firmly constructed; size, 18 by 36 feet and two stories high, with an L to the N., 24 feet square, and of the same height. The storm came upon them as Mr. Hutchins stated, about 7 p. m.; only one strong blast was experienced, and that came from the SW., striking the building in the open corner between the L and the main part, as shown in the accompanying diagram (Diagram 10). The whole building was first moved off the foundation to the NE., when it broke to pieces, the floor of the main part going around to the NW. and the top to the NE. The L. was carried to the N., 60 yards, and then around to the NW. about the same distance, going

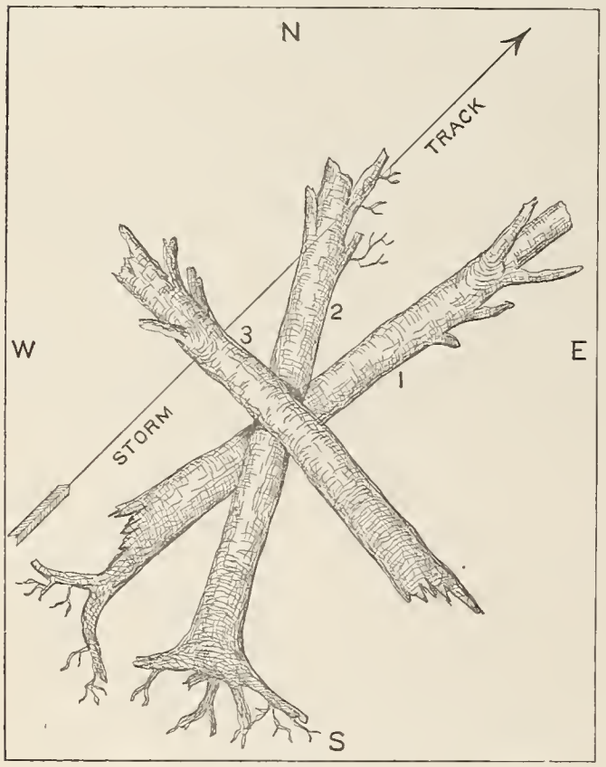


Diagram No. 11.

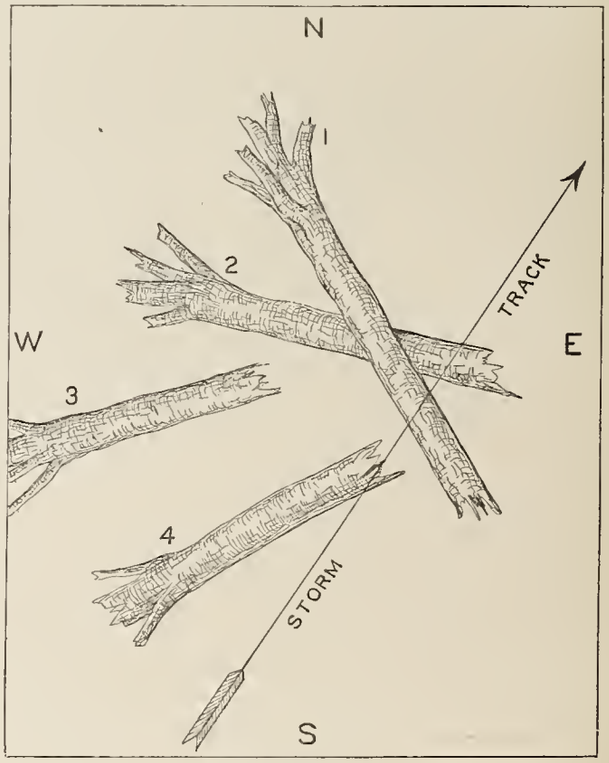


Diagram No. 12.

to pieces in making the circuit. There were seven persons in the house at the time of the storm, but none were seriously injured. A hired man, who was trying to get into the house on the W side, was picked up and thrown to the NW. 30 yards. A log cabin standing NE. of the house 35 feet, was demolished by a portion of the main building striking it. Two others, NW. of the house 50 feet, had their roofs taken off and were otherwise injured. Large pieces of tin piping, guttering, and weather-boarding were found 6 miles NE. of the house. Many pieces of lumber were found at distances of from 2 to 3 miles to the NE., being easily identified by the color of the paint upon them, which no other house had for miles about. A seed-drill and drag NE. of the house 35 yards, were not injured or moved from their positions, yet there was nothing surrounding them to offer protection as far as could be seen. A heavy stalk cutter, made largely of iron, and a hen house by which it was standing, were both demolished, though situated but 28 feet E. of the former implements. Two lumber wagons standing 40 rods NW. of the house, and filled with shelled corn, were broken to pieces and the grain scattered in every direction in such a manner as to prohibit the possibility of its being gathered up. In an apple orchard of 60 trees, S. of the house, 57 were pulled up by their roots and carried to the NE., and one, 18 inches in diameter and 25 feet across the top, was carried 5 miles in a NE. course. The tree was positively identified as belonging to Mr. Hutchins's place, because it was the last orchard through which the storm passed.

About 15 rods W. of the house was the heavily wooded ravine previously spoken of. It was through the eastern portion of this timber belt that I traced the storm's center, from the manner in which the prostrated trees were lying. This course, as indicated, was also corroborated by

statements of members of the family, who saw the funnel-shaped cloud pass west of the house. Sketches of destruction in the timber, made upon the spot, illustrate very clearly the circular movement of the winds. (Diagrams 11 and 12.) As a general thing oak trees, however large, were broken off near the base, stripped of their limbs, or shattered, while hickories, and those trees with a tough elastic fiber, were twisted into splinters. Two hundred and fifty feet SW. of the house stood a group of oaks and hickories, the former from 14 inches to 2 feet in diameter, and the latter 6 to 10 inches. The oak trees were broken off at a height of from 10 to 25 feet; some of the hickories were bent over and twisted (Diagram 13), and others were so severely whipped about as to be shivered and stripped of their bark. But the most interesting and peculiar feature in connection with the destruction of this group, was the fact that the SW. sides (only) of the high stumps were covered with a mixture of fine leaves and mud, extending up to the point where the top was broken off, the other portions furnishing no evidence of a like condition. The greatest thickness of the covering was near the base, gradually thinning out towards the top. The dirt and small grains of sand were fairly driven into the tough bark, and through it in many places. Fifteen days after the tornado, and although subjected to several very severe rain and hail storms, the dirt was over 3 inches thick near the base of the tree, and over 1 inch at the height of 10 feet.

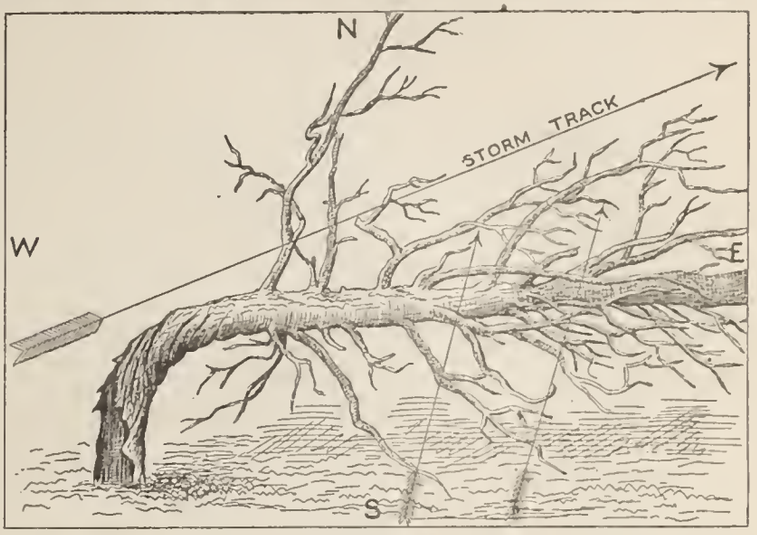


Diagram No. 13.

To show the position of the fallen trees, where the center of the storm passed, I append the following diagram, the arrows indicating the trees (Diagram 14).

Mr. Hutchins stated that his loss would easily reach $5,000, and that it all happened before he had time to realize what was the matter. On his farm of 320 acres, lying mostly E. of the house, not a single rod of fence was left standing. The width of the path of greatest destruction at Mr. Hutchins's house was nearly 1,500 feet—the widest point in the storm's course—and the only house except Mr. Constable's (another wide portion of the track) where heavy timber lay close to it. In every case where the tornado passed through woods the track widened out to an unusual extent.

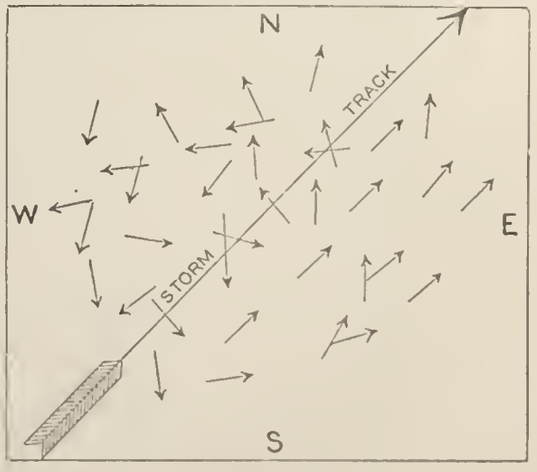


Diagram No. 11.

The next house visited by the storm was that of Mr. Thaddeus W. Warden, tenant on Mr. Cowherd's property, one-fourth of a mile NNE. of Mr. Hutchins's. The positions of the house and barn, regarding the storm's center, are given in the accompanying diagram (Diagram 15). The N. frame part was 12 by 30 feet, the log part 18 by 30 feet, and the S. frame part 18 by 25 feet, all very strongly constructed. In respect to the approach and destructive effects of the storm Mr. J. H. Warden, jr., stated as follows:

At a little past 7 p. m. I saw the dark funnel-shaped cloud whirling terribly and approaching from Mr. Hutchins's. Was standing near the center of the S. frame part and rushed to the S. door to hold it, but before I could pull a chest to the door from a distance of 10 feet, the storm cloud was upon us. The wind struck the S. end of the house first, raising it from the foundation; then the log and frame parts to the N., were struck upon the E. side, also raising them from the foundation, when the top of the entire house fell in, and the whole confused mass was turned over twice to the NW. It was left there but for a moment, apparently to give the whirling current time to pass around

the barn to the W. and S., which it did without injuring it, but throwing down the surrounding trees, as indicated by the small arrows in the diagram. Returning to the house, which it did almost instantly, the violent SW. current carried all but the W. side back to the N., a distance of several hundred yards, smashing everything into kindling wood.

No part of the roof and upper floor had been found, up to the date of my arrival at the scene of destruction.

Mr. Warden, jr., was carried with the house to the NW., and while the current passed to the barn, was held between two of the floors and badly bruised, and on the return of the current was carried to the N. 200 yards. His father and younger brother pursued about the same course, except that the former was blown to the NW. and there remained with the W. side of the house, while the latter was carried to a point within a few feet of his older brother. All of the parties were covered with mud from head to foot; eyes, mouths, and ears filled, and clothing torn into shreds. The oldest son had his head and face cut and shoes torn from his feet, one of them being left at the house and the other carried one-fourth of a mile to the NE. His pants and shirt were torn into strips, hair matted with black mud, and his face skinned and dirt driven into the flesh. The mother and two children were left in the rubbish, the former having her head crushed, and her long hair which reached below her waist, was partly cut and partly pulled from her head, twisted into a rope, and found several feet from her body. That portion of hair left upon her head was twisted into little wisps and mixed with mud. The baby was thrown to the SE. about 20 yards; another child was carried to the W. 112 feet, and two large splinters driven through its thigh, one of which came from Mr. Hutchins's house, it being identified by the peculiar color of the paint upon it. A little girl was thrown 6 rods to the NW., and uninjured. In all cases cuts were made upon the head and bruises upon the body. Every member of the family had their hair matted with mud, and their clothing so filled with it that it was impossible, even after a number of washings, to render the garments fit for use. The bodies of most of the children, after having been washed daily for four days, were still covered with specks of fine dirt and leaves which seemed to be driven into the flesh.

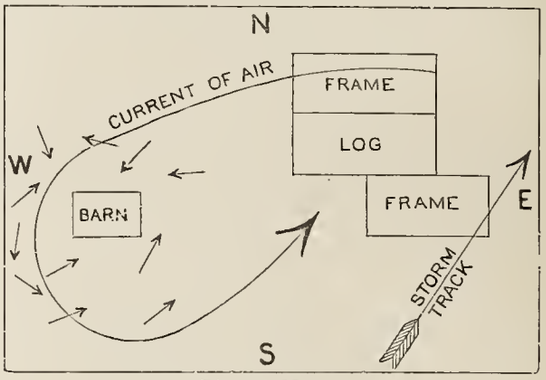


Diagram No. 15.

The following will indicate some of the peculiar freaks of the storm: A carpet upon the floor of the log part of the house and securely tacked about the edges, was taken up and carried out of the house without being torn. A new sewing-machine was broken into forty or fifty pieces. Fine feather beds were torn into strips and the feathers scattered broadcast over the country. Several garments were carried four or five miles to the NE. An iron kettle holding 15 gallons was found broken into six pieces and scattered about in several directions. A 10-gallon keg filled with vinegar was carried to the NE. 40 rods. A large iron-bound trunk, fitted with an extra heavy lock, was torn to pieces, and the lock found a half mile to the NE. sticking into a rail. Several photographs which were known to have been securely placed in an album in the trunk, were found over four miles to the NE. A watch in the vest of Mr. J. H. Warden, was blown 50 yards to the NE. and found covered with mud, but the vest was carried to the E. 20 yards. Several chickens were carried to the NE., from one-fourth to one-half mile and entirely stripped of their feathers. Two stoves were broken into small pieces, and one standing near the middle of the house was uninjured. Heavy bed-quilts were so filled with mud that when dry they were as stiff and hard as boards. A lumber wagon was carried to the NW., 10 rods, the box torn to pieces, and nearly all of the spokes taken out of the wheels. An iron-beam plow, 25 feet W. of the house, was not moved or injured, and a seed-drill and harrow near the barn were also untouched.

The *débris* of the house was scattered over an extent of country 1 mile wide by 5 miles long. The path of greatest destruction was 80 rods wide, but fences were torn down to the eastward for nearly 2 miles. Mr. C. W. Bradley, living one-fourth mile WNW. of Mr. Warden's, experienced only a gentle wind from the SW. His house stood upon a high rise of ground, from which point the storm could be seen in all its fury, and as the dark, funnel-shaped cloud passed over Messrs.

Hutchins's and Warden's he could see the *débris* being carried up the center of the funnel and thrown outward in every direction from the top. Heard the roaring for a distance of 6 miles. The cloud from which the funnel depended seemed to be about a mile in width and hung quite low down, with comparatively clear sky all about it. The funnel cloud, while on the ground at its work of destruction, appeared to be from 150 to 200 feet wide, but it was continually contracting and enlarging except when above the ground, it then maintaining about the same diameter but much smaller than before.

Mr. Bradley and his son, who had been engaged for several days in putting up fences over the path of the storm, were struck with the marked contrast in the comparative width of the E. and W. sides of the storm's track. For a distance of nearly 4 miles they had found that the W. side averaged about 40 rods in width, the maximum being 80 and the minimum 25 rods. On the E. side, over the same distance, the average width was over a mile, the maximum being 2 miles and the minimum three-fourths of a mile.

According to Mr. Bradley's description, narrow paths of destruction seemed to be cut in towards the storm's center on the E. side, from the SW. and SE., making a jagged appearance, while the W. side was comparatively straight. Where fences were thrown down on the W. side, the last panel left standing would, in nearly all cases, be erect and quite firm, but this was rarely the case on the E. side, where the work of destruction was very irregularly committed.

After leaving Mr. Warden's, the cloud partially rose from the surface as it passed up a rise of ground to the northward, causing no destruction until it reached the top of the ridge, half a mile distant. Here it encountered the oldest and largest hedge fence in the surrounding country, displaying wonderful power in its destruction. That portion torn from the ground by the roots was 6 to 10 inches in diameter, and of 15 years' growth. It was considered by all who knew of the destruction that it required more force to pull one of these small trees from the ground than to overturn the largest oak in the forest. The people, for several miles around, were apparently more amazed at the power displayed here than at the houses previously destroyed. The width of the track, as indicated in the hedge, was nearly 500 feet, but it was not all torn down for that distance, only here and there portions, as will be seen in the annexed diagram (Diagram 16).

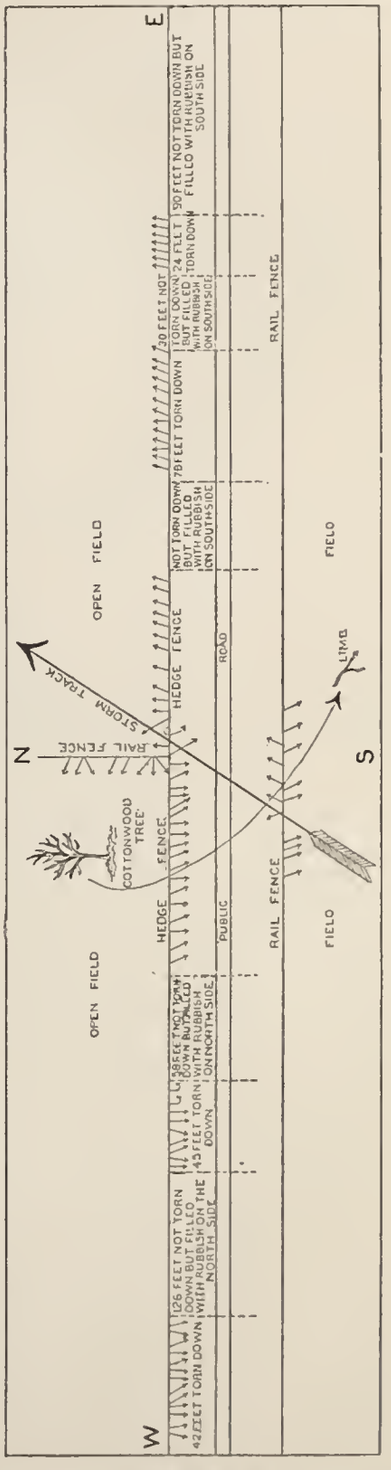


Diagram No. 16.

Mr. W. H. Richardson, who lived half a mile N. of the hedge fence on the property of Mrs. Palmer, gave me a very interesting account of the approach and passage of the storm cloud. The funnel came in at the SW. corner of the farm and passed out at the NE. House stood about 30 rods W. of the storm's center, and escaped uninjured, although the wind blew very violently from the NW. and W., and after the tornado passed was followed by a slight fall of rain. At about 6 p. m. heavy rain, mingled with scattering hail, fell from dark clouds hastily gathered in the W. and NW. This continued for about thirty minutes, when the tornado cloud appeared in sight at Mr. Hutchins's, where trees and broken timber could be seen jerked up into the vortex, whirled about with terrible fury, and then thrown outward at the top. The rain cloud had gone beyond Mr. Richardson's a considerable distance, and the rain ceased when the funnel cloud arrived at the hedge, where it drew down again to the ground, and spread out along the fence to the E. and W. It seemed to stand for a minute or two whirling with terrible velocity from right to left, and this was, in all

probability, the time when the trees were torn out by the roots. Mr. Richardson could distinctly hear, as the funnel passed and while it was at the hedge, a loud sucking noise as if water was rushing into a partial vacuum. Where the center of the funnel passed over the fence, a very large and heavy farm gate was lifted from its hinges, and let down unharmed within 3 feet of the posts.

In questioning Mr. Richardson about the dimensions of the funnel, and the action of the surrounding clouds and currents of air, I received information which led to the preparation of the accompanying sketch (Diagram No. 17). The funnel is represented as reaching the ground, which under such circumstances causes the narrowest part to be some distance above the surface, but when it rises the lower portion tapers down to a very small diameter. Dark masses of clouds shot downward on either side of the funnel, entering it just above the ground, apparently thereafter rushing upward through the center, for immediately following this action, black smoke rolled and rushed out of the top in a frightful manner. During the day, as Mr. Richardson stated, the weather was not hot enough to stop work in the field, but it had been unusually warm for several days previous, with a brisk and continuous southerly wind. The temperature did not change much until Sunday night, forty-eight hours after the storm, but on Monday, the 2d of June, it was cool enough for frost, which some persons reported as occurring in low places. On Thursday, the day before the storm, it rained a little in the afternoon with a S. wind. At the house of Mr. John Goodnight, 3 miles W. of the storm's center in this vicinity, very large hailstones like ragged chunks of ice fell, about twenty minutes before the tornado passed, wind from the NW. at the time. The wind was so strong at the house of Mr. Snodgrass, half a mile E. of the storm's center, that persons could not stand up outside of the house. At Mr. Daniel White's, three-fourths of a mile E. of the storm's center, the wind blew very strong from the SW., and fences were blown down. At the house of Mr. Knox, 1½ miles E. of the storm's center, very little wind was perceptible, but during the passage of the storm, leaves, limbs, pieces of boards, and shingles fell straight down in his yard.

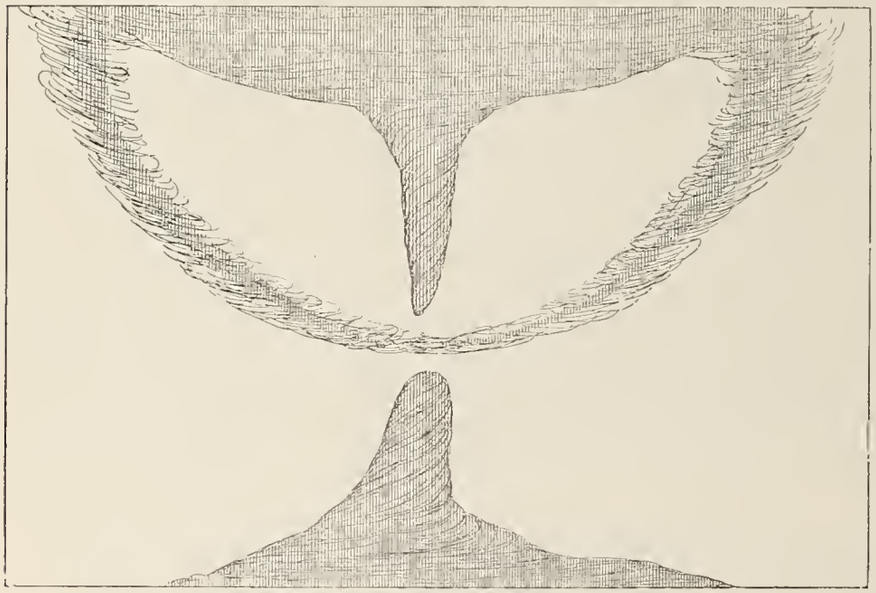


Diagram No. 17.

On leaving the hedge fence at the ridge, the funnel diminished in size and force and again rose from the earth, but only a short distance, now and then dragging its tail over the surface for several rods, without causing any particular damage, until it arrived at the house of Mr. James Black, distant about 2 miles. The building stood upon an elevation of 40 feet, sloping to the S. and E., which the cloud, in order to reach, had to cross, a deep ravine running E. and W.; this was done without disturbing the fences and small trees therein. This ravine, at a short distance W. of the house, turned to the NW. and grew deeper, its sides being lined with heavy timber. There was nothing on the surface to prevent the passage of the funnel cloud up this ravine, had its course been so determined, but the latter led to the NW., while over the high ridge, which offered the only obstruction, if any could be presented, the storm pursued its characteristic course to the NE. The house was part log and part frame, the main part 20 feet square, and an addition to the N., 15 by 30 feet, both one and a half stories high. As near as could be ascertained the center of the storm passed over the house, the *débris* appearing to be carried in circles about the foundation, and in a direction from right to left. The floors were not carried away, being held down by the crumbled mass of the heavy stone chimneys. A wood-house 44 feet NE. of the house,

and the barn and stables, 90 feet to the NW., were entirely demolished and the *débris* scattered about in circles. A lumber wagon was found broken to pieces, hardly a spoke left in the hubs and the tires badly twisted. Two stoves were likewise broken so as to be completely unserviceable.

Mr. John Riley, half a mile E. of the storm's center, had fences blown down to the E., but his house was uninjured. Mr. John D. Selvy's house, three-fourths of a mile E. of the storm's center, and S. of Mr. Riley's, was shaken very severely by a SW. wind. The course of the storm from Mr. Black's, for a distance of nearly 3 miles, lay over the high prairie with a gently undulating surface. The next building damaged was Gore's Chapel, half a mile SE. of Mr. George Prewitt's, 1¼ miles NW. of Mr. Riley's and about 75 rods E. of the storm's center. The building, 30 by 40 feet, and standing N. and S., had both ends moved to the W. 4 inches, and the middle 1½ inches. The plastering was entirely taken off from both ends, but only cracked on the sides.

Mr. John C. Bridges, on the opposite side of the track and to the W. of the center about 250 feet, had his barn, 32 by 42 feet, torn to pieces and the *débris* carried to the N. and E. The entire building was first moved on its foundation to the SE., the S. end 3 feet and the E. side 1½ feet, when it was then destroyed. One of the heavy oak plates, 8 inches square and 16 feet long, was carried 2 miles to the NE. There were 2 tons of hay in the barn, but only 150 pounds could be gathered up after the storm. The house, 100 yards NNE. of the barn, entirely escaped injury. A lumber wagon, 75 yards SW. of the barn, was moved to the E. 8 feet. Twisted stove-pipes, lightning-rods, pieces of farming implements, and kitchen ware were found about the premises and recognized as coming from Messrs. Hutchins's and Warden's, over 4 miles to the SW. A horse weighing over 1,000 pounds, and standing in a field SE. of the barn, was partly carried and partly driven by the force of the wind eastward through a heavy hedge fence into an adjoining field, a distance of 120 yards, where he was found severely scratched and covered with mud. Where the animal passed through the hedge it was bent over, and small furrows cut in the ground by his feet on either side, indicating that he had tried to resist the force of the wind. At intervals of about 40 feet there were indications, by depressions in the ground, that the horse had been thrown down and rolled.

The house of Mr. George W. Prewitt, situated about three-quarters of a mile N. of Mr. Bridges's, was 250 yards W. of the storm's center. It stood N. and S. While the dark cloud was passing, the N. end and E. side only were completely covered with black mud. So forcibly was it driven against the building that the heavy rains for the past fifteen days had failed to remove it, and it was possible to distinguish this part of the house at a considerable distance. Mr. Prewitt was standing, with a child in his arms, in the yard three rods SE. of the house, as the funnel passed. Both were covered with black mud, whirled around and nearly thrown to the ground, some trees near by offering a partial protection against a more violent accident.

Mr. Prewitt positively affirmed that the current of air which swept by the house did not move in a straight line, but that its course was circular and from right to left, as he could distinguish by the sensations of his body. Fencing, over some 15 or 20 acres SE. of the house, was all thrown to the SE. During the passage of the storm the roaring was terrible and the darkness intense.

About one-half mile NE. of Mr. Prewitt's, the storm passed over a stone wall running N. and S., tumbling it down for a distance of 300 yards. The whirl here could be easily distinguished in the small trees and brush growing along the fence. On the south end all prostrations pointed to the E. and NE., while on the N. end they pointed to the W., SW., and S. Mr. William Gore, who lived N. of Mr. Prewitt's three-fourths of a mile and 120 rods W. of the storm's center, stated that the tornado passed him shortly after 7 p. m. House was not shaken by the storm, although standing loosely upon a high foundation. Forty rods W. of the storm's center, about 100 rods of staked rail fence was blown down to the W., S., and N. About twenty minutes before the tornado passed, there was the heaviest fall of rain experienced for several years. It was mingled with scattering hail and came with a NW. wind. On Thursday night it rained a little with a S. wind, but was fair during the day. During Friday it was fair up to about 4 p. m., when dark clouds gathered in the SW. and NW. Mr. F. R. Field, W. of Mr. Gore's, a distance of 80 rods and 200 W. of the storm's center, did not experience any strong wind, but it rained and hailed before the tornado passed.

The width of the path of greatest destruction, opposite Mr. Gore's, was about 40 rods, although some fences were thrown down over a path three-fourths of a mile in width.

The next disaster investigated in the course of the storm was the house of the ill-fated Harris family, situated in a little ravine near one of the branches of Sni-a-bar Creek, one-half mile E. of Blue Springs and 60 feet W. of the storm's center. The funnel, in approaching the house, passed down the S. bank of the ravine across the creek, and through the eastern portion of a grove of small persimmon trees that surrounded it, to the SW., S., and SE. The dimensions of the house were as follows: main part 16 feet square and one and a half stories high, with kitchen attached to the north side, 12 by 15 feet, and one story high. The building was first struck by the wind at the NW. corner, and moved entirely from its foundation to the SE.; then broken to pieces and scattered along the track to the NE. for over a mile. The group of persimmon trees, SW. of the house, were uninjured, although standing but 65 feet distant, while those to the E. and S. were partially bent to the ground, stripped of their bark and foliage, and the SW. side of the trees were blackened as if burnt (Diagram No. 18). This last effect was, in the opinion of many, due to the discoloration of the sap by exposure to the sun, though there were not a few who considered it the effect of electricity; however, no one with whom I spoke concerning the matter noticed at any time during the progress of the storm the presence of lightning in the funnel cloud. This discoloration was not found in any instance under the bark, except where it was loosened from the tree, but not entirely peeled off. Mr. E. H. Jones, who witnessed the destruction at this place, and from whom I obtained a large share of my information, stated that the trees were bent and stripped of their foliage and limbs by a large portion of the house being dragged over them, and not directly by the force of the wind, which, from all appearances, seemed a very probable explanation.

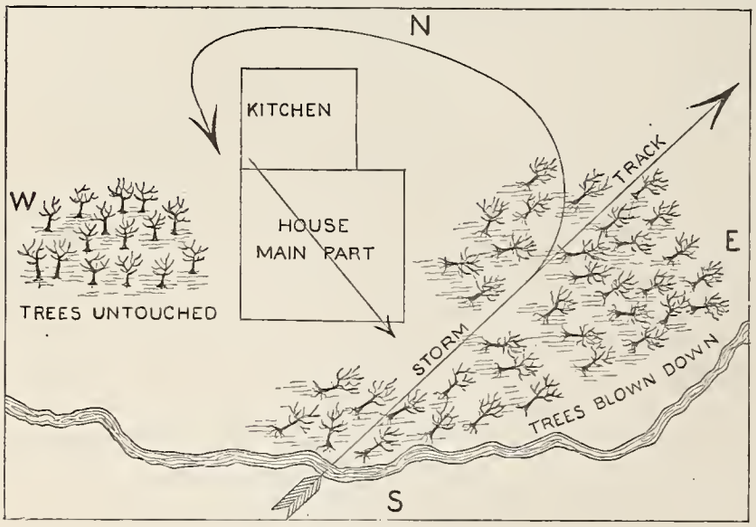


Diagram No. 18.

The family, consisting of father, mother, and four children, ran out of the house on the approach of the storm, the former and one or two of the children first moving to the NW., but thinking that the cloud was coming directly towards them in that position they turned back to the E., and by the time they had reached a point about on a line with the storm's course they were struck by the whirling cloud. The father and baby were carried into a field NE. of the house 150 yards, covered with mud and bruises, and found in the agonies of death. The mother, who had not succeeded in getting as far away from the house as the two former, was carried to the E. 75 yards, and lodged against a small tree, around which she was partially twisted. Her skull was crushed, and she died a few minutes after being found. Her clothes were stripped from her body, which was bedaubed with mud from head to foot. A girl, eight years old, was found dead in the center of the storm's path, 50 yards NE. of the house. A boy was blown into a straw-stack, 45 yards NE. of the house, and another little girl was found 80 yards to the NE., lying in the center of the storm's path. The two latter were not dangerously injured. I was told by several parties, and among them a physician who had examined the bodies of those killed after they were washed, that the entire surface of the body was ecchymosed; or, in other words, they had been so severely dashed about

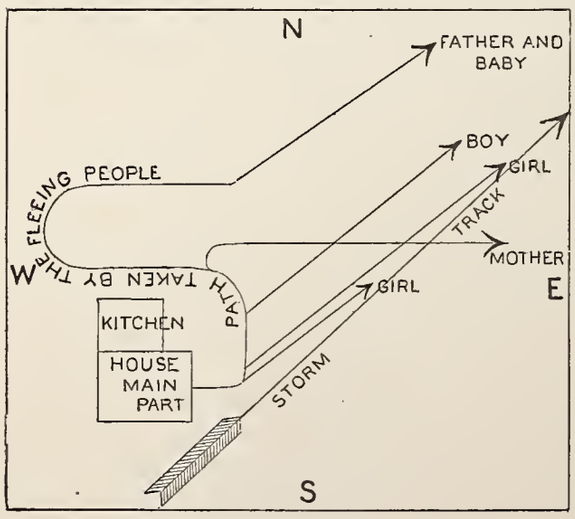


Diagram No. 19.

by the wind, that the flesh was nearly black by the settling of blood in the tissues of the skin. The accompanying diagram will show the relative directions in which the several members of the family were carried (Diagram No. 19). The ground upon which the house stood was swept as clean as if by fire. There was hardly a vestige of clothing anywhere to be found. Now and then a small rag could be seen fluttering from some tree top, caught upon a rail fence, or wound around some broken piece of timber.

The creek to the SE. of the house was choked up with a mixture of straw, rags, feathers, kitchen utensils, rails, boards, and pieces of farming implements. Wagon hubs were to be found with every spoke gone, some broken off and some pulled out. Two heavy $\frac{1}{4}$-inch wagon tires were twisted nearly into knots. The iron mold-board of a plow, one-half inch in thickness, was broken in two and one of the parts driven into the ground a depth of $9\frac{1}{2}$ inches. There was not a single farming implement or article of furniture that was not rendered unserviceable. The width of the path of greatest destruction was 120 yards.

Mr. E. H. Jones, who lives about one-quarter of a mile W. of Mr. Harris's, watched the approach of the storm for several miles. Had a very hard rain and considerable hail with a NW. wind, about twenty minutes before the tornado passed. While it was passing a light misty rain fell, but the hail had entirely stopped some minutes before. The tornado struck Mr. Harris's house a few minutes after 7 p. m., say about 7.15 or 7.20 p. m. Immediately after the destruction a hot moist current, like steam, appeared to rush back from the departing cloud. Several other persons experienced a similar current of air. Mr. Jones particularly called my attention to the fact that the funnel-shaped cloud did not move forward in a straight line while above the ground, but swung from side to side, rising and falling like a huge column of some elastic material. While the funnel was upon the ground this motion from side to side was not observed, but instead there was an upward motion through the center, which could be easily distinguished by the *débris* carried upward, and also a circular motion from right to left, quite as easily discernible by the *débris* and the movement of the dark smoke. There was nothing to indicate on the ground that the general path of the funnel was zigzag. The cloud would shoot to the W. at times with considerable velocity, causing great alarm among the inhabitants in that direction, and then gradually swing back again to its usual course without having produced any injury. The cloud was not seen to make this movement eastward from the center, but always from the center westward, which peculiar feature may receive some explanation from another important fact noticed in connection with the movement, viz, that coincident with it there was a violent rush of air from a southerly point towards the funnel, which generally threw down fences or overturned trees in a narrow path, though sometimes it was not sufficiently strong to cause any damage.

At Blue Springs, one-half mile W. of the storm's center, no damage was done. The wind blew harder with the hail and rain that came from the NW. before the tornado than during its passage or afterwards.

Mr. W. H. Jones, one and a half miles W. of the storm's center, heard loud roaring, but did not feel any brisk wind except the hot current which rushed back from the cloud after its passage eastward. Persons who lived 5 miles W. of the storm's center told him that they also felt this hot wind. Saw the cloud when it disappeared from the earth near Judge Williams's, several miles to the NE. It appeared to divide about 80 feet from the ground, the lower portion, about 30 feet in length, coming to the earth, not instantly, but in the course of 30 seconds, while the upper portion slowly drew itself up into the overhanging clouds. It was about five minutes after this occurred that the hot current was experienced from the NE., while at Lee's Summit and vicinity a similar current was felt from the SW., but the latter was at the commencement of the storm's destructive effects and the former at the finishing touch.

The next work of destruction, after leaving Mr. Harris's, was at the house of Mr. Oliver Underwood, on the property of Charles Young, three-quarters of a mile to the NE. The building stood 100 yards W. of the storm's center, size 20 by 36 feet, and one story high. It was completely demolished, the roof being carried almost entire, first to the NW. about 150 yards, and then in a half circle by the W. to the S., and deposited within 25 yards of the storm's center, crushing it by the fall, from which point the pieces were then scattered in the N. and NE. along the storm's path.

(Diagram No. 20.) The stable, which was very near the center of the storm, was blown to pieces, and the *débris* carried to the NE. and NW. The family ran out of the house on the approach of the storm, and moved near the eastern edge of its path, throwing themselves flat upon the ground and grasping the trees near by. They were whipped about them several times and lifted up and down, the father making quite distinct impressions in the soft ground where his knees repeatedly struck.

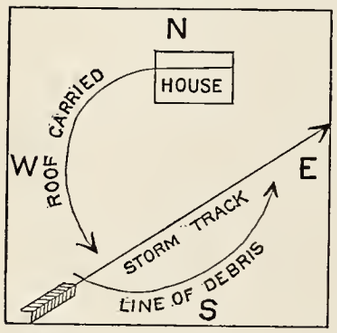


Diagram No. 20.

The storm next encountered the house of Mr. Martin Gore, 1¼ miles NE. of Underwood's, and 60 feet E. of the center of the track. It was completely enveloped in dark smoke, whirling rapidly, and so intense that Mrs. Gore could not see her children who were within almost arm's reach. The house was severely shaken, but not torn down. A log stable, 120 feet W. of the house and 20 feet W. of the storm's center, was torn down, the roof carried 30 yards to the N., and the remainder of the building to the W. and S. A smoke-house, 30 feet W. of the house, had its roof blown 50 yards to the S. A well-house, half way between the two former, was carried 300 yards to the N. The entire width of the storm track at this place was about 250 feet, while a mile to the SW. it was one-quarter of a mile. The buildings stood upon higher ground than at the previous places of destruction, as the cloud was gradually ascending a high "divide" to the N. The intensity of the tornado was considerably diminished, for had Mr. Gore's house stood the same distance from the storm-center, 1 mile to the SW., it would have been torn into splinters, and the surrounding buildings more completely destroyed. People in the vicinity noticed also a marked change in the intensity of the roar of the storm, it dying out gradually until it almost disappeared, as the funnel drew up into the clouds above.

At Mr. George Smith's, only 300 yards E. of the storm's center, in this vicinity, no damage was committed except that a few small trees were blown over. At Mr. C. H. Young's, 600 yards E. of the storm's center but further S. than the former place, no damage of any kind was committed, but a brisk SW. wind prevailed.

Mr. J. K. Reed, one-half mile E. of the storm's center and 1 mile SE. of the spot where the funnel disappeared, stated that the air was nearly calm, and drops of mud fell like rain about the house for a few seconds, daubing the face and clothes of those outside watching the storm. After the cloud "bursted" a hot, moist current of air was felt for about ten seconds coming from the NW., not as a direct current but in a whirling manner. It was quite clear in the W. just after this occurred, but still threatening in the NE.

Mr. Thomas M. Cunningham, one-quarter of a mile E. of the storm's center, and three-quarters of a mile SE. from the spot where the funnel disappeared, did not feel any strong wind while the cloud was passing. Watched the funnel-shaped cloud for some time before and also when it vanished. Mr. Cunningham considered the time of disappearance as very near 7.30 p. m., or just as the sun was setting. After leaving Mr. Gore's the tornado cloud moved forward to the dividing ridge between Blue and Sni-a-bar Creek, about three-fourths of a mile distant, and when it had reached the summit (from which point any part of the country could be seen within a radius of 5 miles) the funnel bursted as previously described. This operation occurred over a cornfield on the farm of Mrs. Rider, in section 19, township 49 N., range 30 W. The corn was covered with mud and severely whipped and the ground apparently deluged with barrels of water for a width of 30 yards. The rail fence just beyond this spot to the N. was blown down for a space of 50 yards This constituted the entire damage at this point, and was the last I examined or heard of in connection with the storm. There were some uncertain reports current that the tornado had crossed the Missouri River at Wellington, La Fayette County, drawing up large quantities of water. I did not visit the place to verify the statements, as I was positively assured by men who had been there, and also by those who lived near the town, that no such thing had occurred. Heavy rain and considerable hail fell shortly after sundown, but no damage resulted. With respect to this question, and concerning the disappearance of the funnel cloud, Judge A. G. Williams, living a short distance N. of Mrs. Rider's, sent me the following communication:

I have no knowledge of the tornado doing any damage beyond Mrs. Rider's farm. If it reached Wellington I have no knowledge of it, either public or private. When I first saw the tornado my attention was directed to the breaking of the rain-cloud, and I noticed what I supposed to be a water-spout such as Professor Maury describes in his geography as occurring on the Indian Ocean. It seemed to be about the size of a man's body where it touched the clouds above, and then tapered down to the size of a mere rod. It appeared to create quite a whirl among the clouds which it came in contact with, and to worm itself up into the cloud above like a large auger entering a hole. The funnel commenced to break up and scatter after it had reached the high ground at Mrs. Rider's, but I was prevented from tracing the shape of the cloud from top to bottom because of the shade trees in front of me. I did not lose sight of some slight recognition of its form (the upper portion of it) until it had reached a point not exceeding ¼ mile NE. of my place.

Dr. Fred. A. Ballard, of Independence, Mo., and correspondent of the Kansas City Journal, who was employed by that paper to write up a report of the Lee's Summit storm, sent me a communication, date of July 7, stating that since his last conversation with me he had received additional information concerning the course of the storm after leaving Blue Springs; that instead of passing over Wellington, as reported, it had crossed the Missouri River at Sibley, a point considerably W. and N. of the former, and almost due NNE. of Blue Springs, thus approaching more nearly the course the storm had previously pursued. At Sibley, during the prevalence of a rain and hail storm in the early part of the evening, a loud roaring noise and rushing of the air was distinctly heard overhead, but no funnel cloud descended. From thence the storm passed over Knoxville, Ray County, Missouri, where, later in the evening, similar atmospheric disturbances were experienced, and *débris* was deposited. A summons, taken from the office of a justice of the peace, located southeast of Lee's Summit, fell at this point, where it was discovered shortly after the storm and identified.

The whole distance traversed by the storm, supposing it to have reached Knoxville, was not less than 86 miles. The distance over which I traced the effects of a well-developed tornado from near the Kansas State line to where it rose from the earth beyond Blue Springs, was 52 miles. That portion of the track which proved to be the most destructive was from Lee's Summit northeastward, a distance of 20 miles, following, very closely, the line of greatest elevation between Little Blue River and Sni-a-bar Creek, crossing it twice in that distance. As to the time occupied by the storm in passing over the track of 52 miles, no data that could be considered accurate, except, perhaps, that given by Mr. Van Meter, living near Lee's Summit, whose clock stopped by the shaking of the house at 6.30 p. m., could be obtained. This hour coincides very closely with the time given by Daniel Cline, and also Dr. Dunnington, whose houses stood a short distance to the SW. The time given for the disappearance of the funnel cloud beyond Blue Springs was about 7.30 p. m.; this would make the progressive velocity of the storm between Lee's Summit and Mrs. Rider's about 22 miles per hour. From the place of its first appearance to the town of Lee's Summit, covering the longest portion of the track, or about 30 miles, and while the cloud was above the ground, the time occupied was 1 hour, or from 5.30 to 6.30 p. m. This last calculation is simply a rough estimate, as it was impossible to obtain anything but a probable guess as to the minute of time at West Line or in the vicinity. Every one questioned, gave the time as between 5.30 and 6 p. m., and I have called it 5.30 p. m., as it seemed the most consistent conclusion, considering the hour at, and the distance to, Mr. Van Meter's, whose time I use as a sort of datum point, being from all appearances the most reliable. Upon this basis of calculation the progressive velocity over the first portion of the track was 30 miles per hour, an excess of 8 miles per hour as compared with the velocity over the second portion, or an average of 26 miles per hour for the whole distance.

The difference in the velocity between the northern and southern portions of the track may not appear strange, when it is considered that over the latter the funnel cloud was above the ground, not meeting with anything to call for a development of its force or retard its progress, while the contrary was the fact over the former portion. It was the testimony of several persons along the northern portion, that the tornado at times appeared to be moving slow enough for them to have walked briskly before it and kept out of its way. Again, at several points it appeared to stop for a moment or two, and again to move over short distances of from one fourth to one-half mile at a velocity of about 60 miles per hour. The course of the storm over the southern portion of the track was more duly NE. than over the northern portion, where the cloud bore more to the N. after leaving Lee's Summit, taking a NNE. direction.

THE CLARINDA TORNADO.

I heard of this storm while in Missouri, not as a tornado, which it proved to be, but as a heavy NW. storm. Many of the facts were kindly reported to me by Dr. Kridlebaugh, of Clarinda. This town is situated upon the Nodaway River, in the eastern portion of Page County, Iowa, within 40 miles of the Missouri River, and 14 miles N. of the Missouri State line. The morning was fair and suggestive of pleasant weather, but at about 2 p. m. an occasional rumble of thunder was heard in the NW., when soon after a much disturbed and heavy cloud appeared in that direction, and one of like character in the SW. The former was in terrible commotion, and the whirling, shooting clouds seemed to predict a storm of unusual fury. Says the doctor:

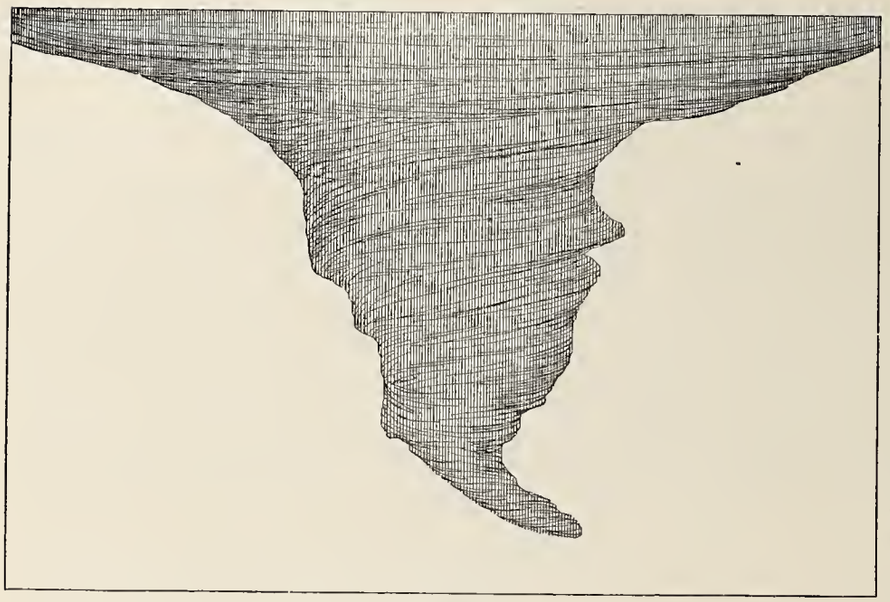


Diagram No. 1.

I watched both clouds from their first appearance; the one from the SW. especially alarmed me, as it looked green and dirty, boiling up dreadfully in the center, and presented an unusual appearance, the lower portion being prolonged into a cone-shaped mass, and apparently dragging the smaller end upon the earth. (Diagram No. 1.)

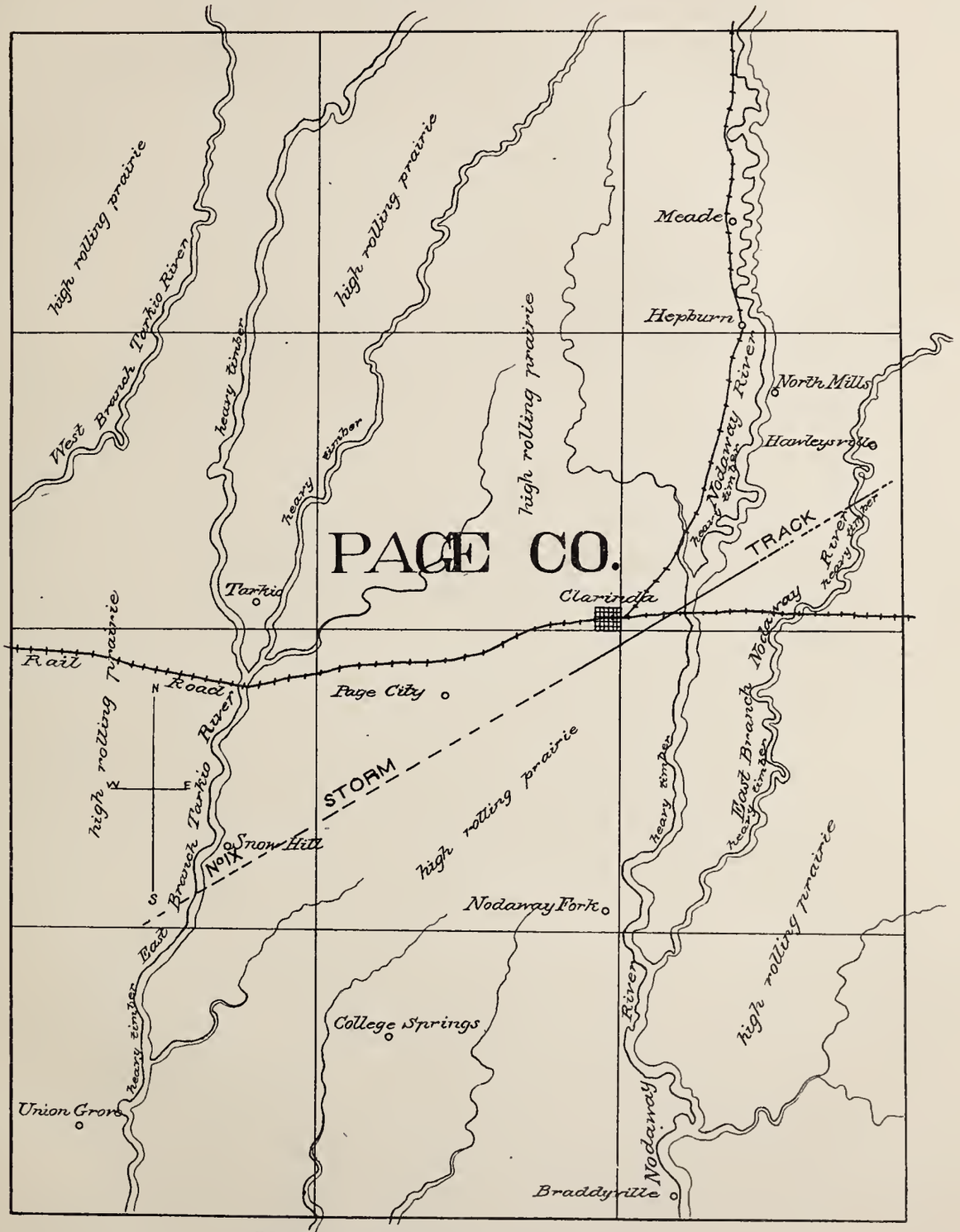
The heaviest portion of the storm passed S. of the town, as within its precincts but little wind was felt, and the hail-stones together with leaves and *débris* fell straight to the earth. The large covered bridge (Howe truss) across the Nodaway beyond the city was badly damaged. It was first struck on the S. side, and despite the heavy iron rods which held together the braces, the structure was torn apart, the side braces between the sills and plates carried into the river, and the upper stringers with portions of the roof fell to the floor. Large trees were twisted off near the bridge, giving evidence of a whirl or auger-like motion to the current of air, from right to left. The course of the storm was from SW. to NE. Rain commenced at 2 p. m. and hail five minutes after, lasting until 2.15 p. m., with a precipitation of 0.55 inch of rain and melted ice. The mercury in Fahrenheit's thermometer stood at 80° at 2.05 p. m., and 70° at 2.15 p. m. The following is taken from the Clarinda Herald of June 5:

About two o'clock in the afternoon, on Friday last, a terrific and destructive hailstorm, accompanied with heavy rain, passed over our city in rather a NE. direction, lasting about ten minutes. The hail stones were quite large, measuring 3 inches in circumference. The ground was soon thickly covered with them. As there was at this point but little wind, they descended perpendicularly to the earth, but were precipitated with such force that the sky-lights, wherever found, were broken out completely. The green leaves fell as rapidly as the leaves of autumn. All kinds of fruits and garden products were injured. The cherries were literally picked from their stems. The belt or track of this storm was quite narrow, perhaps not more than a mile in width. While in town we had scarcely any wind, about half a mile E. of us it was so heavy that some of the railroad bridges, and the covered bridge across the Nodaway, were badly damaged. Mr. M. G. Blair, E. of town, had a large barn completely demolished and several pigs killed. There were eight horses in the barn, which, for a wonder, were not hurt. The house of a Mr. Hodgkens was lifted around, and shingles were ripped from the residence of Mr. Frank McMahan. It was one of the worst storms ever known in this vicinity.

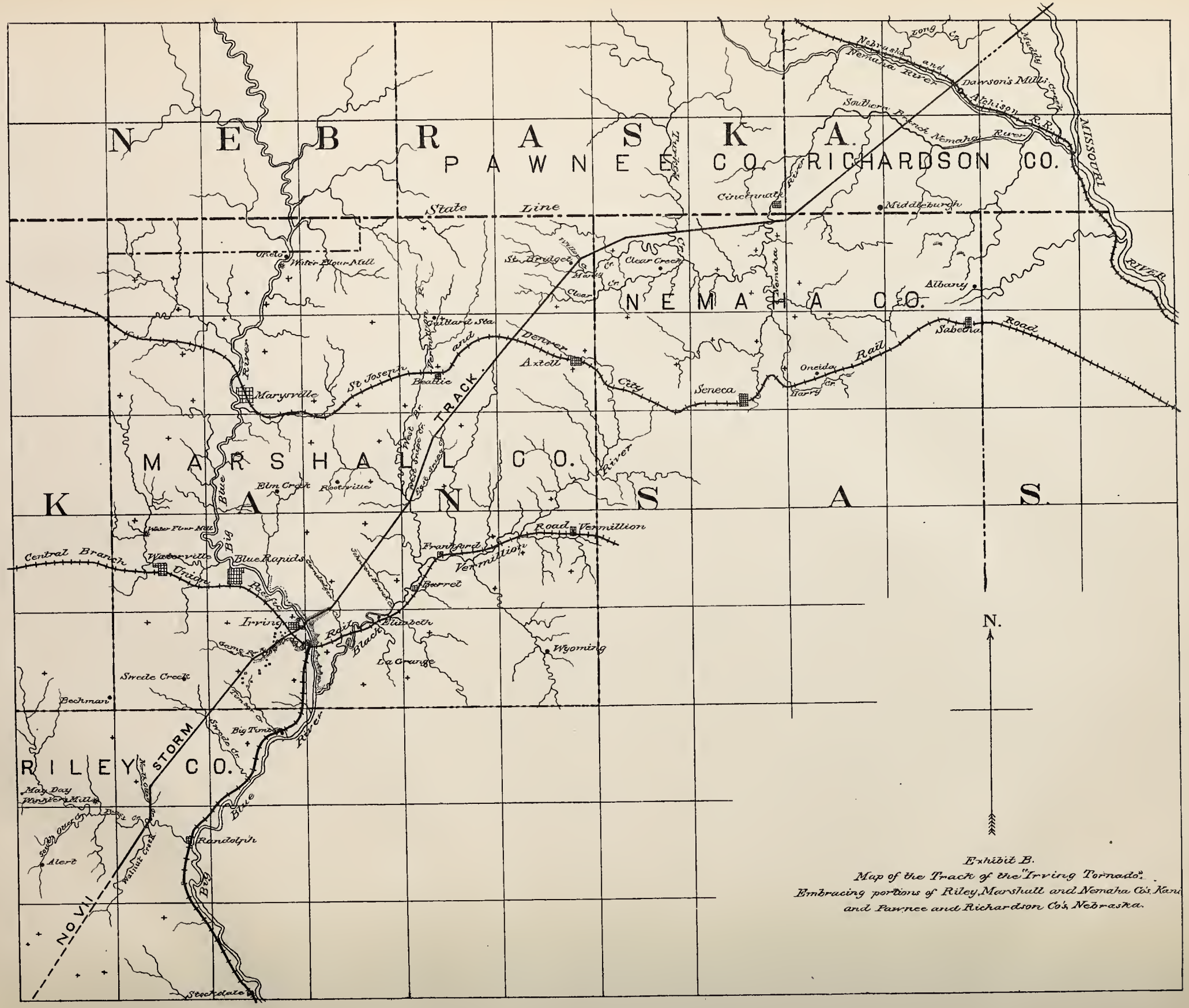
The NW. storm spoken of in the Irving tornado passed this place about 8 p. m., as will be seen from Dr. Kridlebaugh's statement:

At 8 p. m., a nimbus (rain) cloud appeared in the NW., accompanied with high wind, loud thunder, sharp electrical discharges, and a gale of about 40 miles per hour. Heavy precipitation, with a violent wind, lasted fifteen minutes, and was followed by a slow drizzling rain all night. The amount of water in the gauge at daylight on the

Exhibit A.
Map of the Track of the "Clarinda Tornado."
Page Co. Iowa.



Width of creek and river bottoms, ¼ to 2 miles.
All streams heavily wooded, Bolt ⅛ to ¼ mile wide.


NEBRASKA.
PAWNEE CO.
RICHARDSON CO.
NEMAHA CO.
MARSHALL CO.
RILEY CO.
KANSAS
State Line
Nebraska and Nemaha River
Southern Branch Nemaha River
Missouri River
Cincinnati
Middleburgh
Albany
Sabetha
Road
Rail
Oneida
Seneca
Clear Creek
Stuttgart
Marys Cr
Clear Cr
Denver and Axtell
St Joseph
Beattie
Marysville
Blue River
Elm Creek
Hooperville
Waterville
Blue Rapids
Central Branch
Union
Pacific
Irving
Frankfort
Vermillion
Barret
Elizabeth
Wyoming
La Grange
Smoke Creek
Bechman
Big Timber
Randolph
Alert
Stockdale
Black
Big
Blue
TRACK.
STORM
NO VII
N.
Exhibit B.
Map of the Track of the "Irving Tornado."
Embracing portions of Riley, Marshall and Nemaha Co's, Kan.
and Pawnee and Richardson Co's, Nebraska.

morning of the 31st was 1.2 inches. The storm did much damage in town, lifting the house of Mr. Simms off its foundation, and breaking large limbs off of the shade trees in the park and elsewhere about the suburbs. A schoolhouse 1 mile N. of town, district No. 12, was considerably wrecked by being thrown off its foundation on the SE. corner, and doubtless would have been torn to pieces, had it not been a ceiled house instead of a plastered one.

Many old citizens say they never saw a more terrific hailstorm in Iowa. The storm after passing this point, struck Bedford, Taylor County, where it also did much damage.

THE IRVING TORNADO.

The present storm, which proved to be the longest of any examined, and also the most destructive, especially to life, first appeared over the heavy rolling prairie of Bala Township, Riley County, Kansas, near the source of no less than five creeks, which flow to the SE., ESE., E., NE., and NNE.

Over a series of ridges alternating with heavily wooded bottoms from 60 rods to a mile in width developed the first stages of the storm. From the house of Mr. T. Naninaga, near Walnut Creek, where the first destruction occurred, there was observed forming in the SW. and NW. about 4 p. m. dark, heavy clouds. Their appearance was considered nothing unusual except that they came up very suddenly, first from the NW. and then the SW. In fact, a storm was rather expected, because of the sultry and close condition of the atmosphere, which had continued most of the day with a southerly wind. In a short time the clouds which had come up so quickly and quietly were thrown into the most terrible commotion; huge black masses mingled with lighter clouds, would roll upward in front of and between the opposing currents, the latter sometimes shooting upward with lightning velocity. Rain and large hail had already commenced to fall, and in about fifteen minutes the whirlwind of destruction formed, having the shape of a huge elephant's trunk, and gradually lowered itself towards the ground. As it passed (yet above the surface) to the W. of Mr. Naninaga's, his corn-cribs and stables were destroyed, and about 150 bushels of corn strown along the prairie. The *débris* was all carried to the NE., N., and NW. The house was severely racked by a SW. wind, but not destroyed. The storm next unroofed the house and stables of Mr. Peter Nelson, half a mile to the NE., carrying the *débris* along the track to the NE. for several hundred yards. Mr. C. A. Gouranson, the last resident on the high prairie before reaching what is called "Hanson's Ravine," which cuts off from the "divide" running ENE. towards Walnut Creek, was next reached, and his house unroofed. The smaller and weaker outbuildings were entirely demolished. The storm, from its inception, had followed the "divide," running from SW. to NE., between Walnut Creek to the E. and South Otter Creek to the W., a distance of about 7 miles. It then descended the "Ravine" and northern slope of the "divide" to Fancy Creek, a large stream running from NW. to SE. and emptying into the Big Blue River at Randolph. At this point a smaller funnel cloud shot off from the main one and passed down the "Ravine" to the NE., while the latter continued down the slope of the "divide" to the N.

In the bottom of the "Ravine," the house of Mr. Thumbloum was simply turned over to the NW., and the roof blown off from the house of Mr. Lewis Peterson; both buildings stood E. of the storm's center about 20 rods. The house of Mr. Lewis Hanson, standing W. of the storm's center 35 rods, was deprived of the kitchen, which was attached to the S. end of the building, the largest portion of it being taken up into the air and scattered, no one knew where. The small funnel cloud now reached the timber on Fancy Creek, 2½ miles NW. of Randolph, which it destroyed, with terrible fury, embracing all of the irregularities of the creek's course for a width of half a mile. As the tornado first crossed the creek the large stone barn of Mr. E. Seerest was unroofed and the S. gable-end blown in. This building stood on the southern side of the wide bottom lands which spread out to the N. and E. for nearly a mile and a half. NE. of the barn and nearly across the valley, a new and large church building was completely wrecked, and the *débris* carried forward in the track of the storm for one-fourth of a mile.

This, to all appearances, was the last destruction committed by the *small* funnel cloud. The *large* one, before crossing Fancy Creek, struck the large two-story house of Mr. Weisdanger, entirely destroying the second story and roof, except a portion of the E. wall. The building was situated 25 rods W. of the storm's center and first struck by the wind from the N., the *débris* being carried to the W., SW., and S. Large stones weighing from 150 to 200 pounds were carried about

300 feet. Out-buildings standing E. of the house and nearer the storm's center were more completely demolished. The house of Mr. Charles Peters, still farther W. of the storm's center, was considerably racked, but not otherwise damaged. In crossing through the heavy timber on Faney Creek, the destruction was even more fearful than that produced by the smaller tornado. Large oaks 3 feet in diameter were broken off like pipe-stems, and tough elms nearly as thick were twisted into ropes.

The two clouds were now on the northern side of Fancy Creek close to the mouth of North Otter. Here the two tracks which had previously been separated about 1½ miles, merged into one. In this separation, I refer to the distance apart of the centers of the paths of greatest destruction, which corresponds very closely with the immediate diameter of the dark mass of clouds which formed the funnel. A strong wind prevailed between the two clouds of sufficient force to destroy small trees and overturn fences. It was quite a difficult matter to trace the respective courses of the two storm clouds, which were reported to have passed over this section, because their supposed points of meeting and separation were located among the ridges and heavily wooded ravines of several creeks, where the timber was more or less destroyed for a width of 2½ miles. The storm certainly spread out here to an unusual width, but it was the case in all of the tornadoes where timber was encountered, caused in all probability by the opportunity offered to the revolving current of air to reach out and constantly find well suited material for its fury to feed upon, and also the fact that in a heavy forest the resistance offered to the developing energy of the storm cloud, as the inrushing currents of air attempt to reach the vortex of the whirl, is increased many fold, thereby concentrating from point to point the extreme limit of the tornado's power.

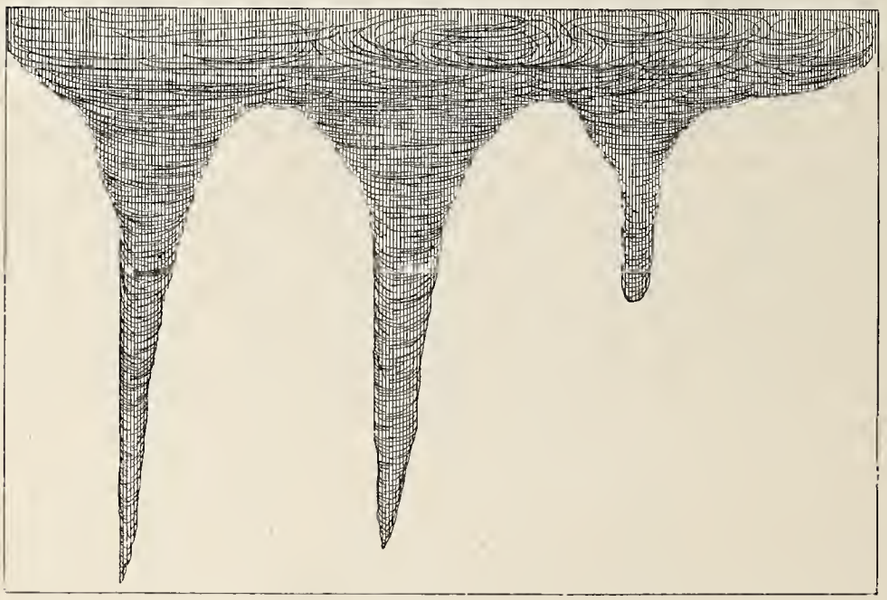


Diagram No. 1.

While the storm was raging with demoniac fury in the timber, the people of Randolph were looking on with fear and trembling. Mr. Alfred A. Parkerson, one among many who watched the formation of the tornado at its inception SW. of Faney Creek, stated that during the day the wind had been from the S. most of the time, and the weather unusually sultry. About 4 p. m. clouds began to gather in the W. (wind still S.), with every appearance of a very hard storm. Shortly before 5 p. m. a light breeze came from the N., which kept increasing in force and finally blew very hard, when new and strange looking clouds seemed to dart up along the horizon, from the S. around to the NW. with amazing rapidity, and rush towards a very black spot, apparently about an acre in size, directly in the W. In about five minutes a whirling motion was discernible in the black center, resulting in the gradual development of a small funnel-shaped cloud, which wound itself downwards towards the ground, where its tail, at the distance of between 3 and 4 miles did not appear larger than a man's leg. In about three minutes another funnel formed on the right of the former, extending part way down to the ground, and still another formed on the left, reaching entirely down to the ground. (Diagram No. 1.) The main funnel appeared to be stationary, until these smaller ones formed, when it moved with its companions towards Fancy Creek, causing the people in the town to seek places of safety in cellars, "dug-outs," and wherever else they might hope for secure shelter. After passing by the heavy belt of timber along the creeks the two smaller funnels disappeared.

While the tornado was passing the atmosphere surrounding the town of Randolph was nearly calm, and occasionally large hail stones would fall straight to the ground. The roaring of the storm, particularly when in the timber, was like the rumbling of a thousand trains of cars. Mr. Henry Condray, of Randolph, who also witnessed the three separate funnels, stated that during the day the wind was blowing from the SE. stronger than for some weeks past, and at 4 p. m. light rain fell but no hail. Half an hour after the tornado passed, a very heavy rain came from the NW. with a remarkably cold wind.

The three funnels reported by these gentlemen, taken in connection with the supposed division of the storm's track, as before stated, would seem to add largely to its probable occurrence. The division is not at all improbable, although the evidence furnished by the track as I saw it, which was many days after the storm, during which much of importance was obliterated, was not very strong.

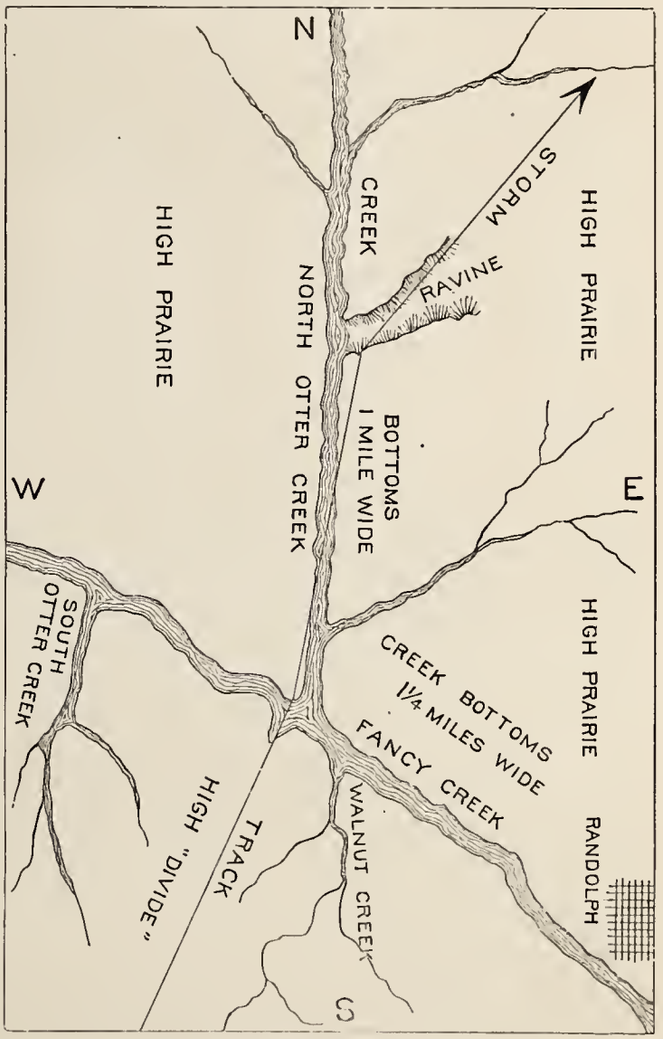


Diagram No. 2.

The storm left Fancy Creek near the month of North Otter, up which it passed for about 2 miles to the N., first encountering a stone school-house about 70 rods W. of the storm's center, which it unroofed, carrying the *débris* to the W. and S. A portion of the E. wall was thrown inward, crushing the seats. The scholars were dismissed a few minutes before the storm struck, going to neighboring houses for safety. Across the creek bottom, three-fourths of a mile to the NE., stood the house of Mr. Heller, who saw the two funnels before spoken of unite after passing Fancy Creek, at a point about half-way between the church and school-house, but being terribly frightened from the expectation that his entire property was to be destroyed, he could recall very little concerning the particulars of the junction. His house barely escaped destruction, having a few shingles taken from the roof and a lightning-rod torn down.

One-half mile NNW. of the school-house the storm struck the house of Mr. Adam Schwein, which stood 250 feet E. of the storm's center, the cloud following the creek quite closely. The building was part stone and part frame; size, 16 by 28 feet and one and one-half stories high. It was swept from the ground in an instant; no one seemed to know just how. Within were gathered at the time, three of the school-children besides the family, numbering eight in all, who were each and every one buried beneath the ruins. The father was badly bruised about the hips and hurt inwardly. The mother was not dangerously hurt, but an infant held in her arms was instantly killed. Their little daughter had her head crushed to a jelly by falling timbers. The remainder escaped with a few bruises. The clothing and furniture were totally ruined, shreds of the former being found one mile from the house hanging in some tree-tops. Trees in the yard about the house were stripped to bare poles, and about them in several instances were wound the remnants of what were once whole garments. Beds, bedding, stoves, crockery-ware, and tinware were strewn along the track in shapeless ruin for hundreds of rods. The once happy home was desolated as if by fire—worse than fire, for it was the work of an instant—dashed into eternity and oblivion without the slightest opportunity for defense or escape.

For the distance of a mile and a half still farther N. the funnel cloud followed the stream, not as closely as before, but bearing off gradually more and more to the E. over the wide creek-bottoms, approaching the high rolling-prairie, which it soon reached by traversing a little wooded ravine that led out of the creek to the NE. (Diagram No. 2.) Throughout this ravine nearly every tree, both large and small, was either broken off, uprooted, or divested of every leaf and limb, and the earth fairly shorn of its covering of prairie grass.

Throughout the storm's entire course along North Otter Creek, in the heavy timber, trunks, limbs, and foliage were torn and shattered in the most fearful manner. Often the limbs of one large monster were found completely woven into those of its neighbor, and always in a direction from right to left. Many times the very center of the funnel appeared to have traversed the bed of the stream. The width of the path of greatest destruction averaged 275 feet. In several sections of the track which were closely examined, the trees generally lay pointing to the NE. and N., on the E. side of the center, lying across the track from E. to W. along the center, and on the W. side pointing to the WSW. and SE. There was no portion of the track where a well-developed whirl was not evidenced by the destruction. Hardly a tree or limb, unless partially rotten, but what bore some evidence of being twisted.

Upon reaching the high prairie the cloud passed along the undulating surface for a mile and a half until it reached the house of John Daly, standing a considerable distance W. of the storm's center, which it unroofed, and, in like manner, the house of Mr. Ericson, one-fourth mile to the NE. Both houses stood upon ground below the general level, yet not really in a ravine. A horse belonging to the last-named farmer and picketed out upon the prairie near the storm's center, was carried up into the air, in all probability a considerable distance, as nearly every bone was broken when it fell.

The tornado now lifted from the ground, which presented nothing in its topography materially differing from that already passed over since leaving the creek, and continued a direct NE. course over a section of the prairie very thinly inhabited. A few inconsiderable out-buildings were overturned, but no damage of importance was committed. Upon reaching the head of Swede Creek 5 miles NE. of North Otter, the small house of a Bohemian standing upon a slight rise of ground was blown down, but not torn to pieces. Four miles farther to the NE. the storm cloud reached the head of Timber Creek, where the stables and out-buildings belonging to Albert Beeckman were demolished, the funnel passing within 200 or 300 feet of them to the W., but still above the ground. At both of these creeks the timber, even in the lowest parts of the bottoms, was not destroyed as heretofore; only the tops and an occasional trunk were found twisted or broken off, showing that the funnel had not dipped downward, but remained at the same level as upon the high prairie. The manner in which the buildings were destroyed also indicated the existence of the cloud above the surface. In every instance they were either simply unroofed or toppled over and crushed in falling, and the *débris* without an exception was thrown in the direction in which the storm was moving.

Another important fact was the existence of only one current of air, in these cases of destruction, following in the wake of the cloud from the SW. The atmosphere was generally very quiet as the cloud came up, followed as it passed by a loud roar and a swift rush of the air as through a vacuum, not disturbing, however, the lightest article outside of its narrow path of from 60 to 100 feet.

At the distance of 1½ miles to the NE., the tornado crossed the line of Marshall County, partially destroying the house of Nathan Wentworth, situated 80 rods SW. of the point where the ground began to descend to Game Fork Creek. The cloud commenced to descend again to the surface and widen its path of destruction. Sixty rods E. of Mr. Wentworth's a school-house was unroofed and the *débris* carried to the NE. and N.

The storm's path was now one-fourth of a mile wide, but the cloud is still upon the high prairie. The houses of Edward Wentworth, Gavin Reed, Robert Reed, and Wesley Cooper, situated in the bottom of a "draw" leading into Game Fork Creek from Timber Creek, in an ENE. direction, were next reached and fairly ground into pieces. Hardly a board 6 feet long was left near the foundation of any of the buildings. The funnel as it passed from the high "divide" to the "draw" perceptibly widened at the bottom; but, without bodily swooping downward at once,

it drew the buildings up into its vortex and then twisted them to pieces. The house of Robert Reed, 16 by 24 feet, and one and a half stories high, was lifted up as easily as a feather, and without at first cracking the timber. So quickly was it done, that before Mr. Reed, who was within, knew of his danger, the building had risen a height of 25 feet or more. The house being then enveloped in darkness and not knowing what had happened, he started for the door, thinking it time to make good his escape, when, instead of stepping out upon the ground, as he expected, he fell the above-named distance, injuring himself severely.

In passing down the "draw" the timber was torn in a dreadful manner, but leaving the clearest evidence of the existence of the characteristic whirl. The large frame building of Mrs. Noak, 80 rods W. of the storm's center, was torn to pieces and the *débris* carried to the SW. and SE. Mrs. Noak was instantly killed by a falling timber.

The cloud now rose out of the "draw," and passed over a ridge about 75 feet high to the NNE., overturning the house of Mr. Moses, but not otherwise injuring it. For the distance of 120 rods it continued its course upon the high ground, when it reached another little "draw," running from SE. to NW., down which it passed for about 60 rods to Game Fork Creek, making a descent of 175 feet, destroying the house of Mrs. Miller, at the foot of the bluff. Hardly a vestige of the building remained. The tornado now encountered the timber again, making its usual havoc and widening out a distance of three-fourths of a mile. As it reached the southern bank of Game Fork Creek, a cluster of small houses, occupied, respectively, by Mrs. Brown, Henry Wilson, John Casey, and George Martin, were completely leveled to the ground. Mrs. Martin was killed by the falling timbers. Martin's house stood on the extreme eastern edge of the storm's center and Casey's on the extreme western edge, one-half mile apart. The *débris* from the former was carried to the NE., N., and NW., and of the latter to the W., SW., and SE. Mrs. Brown's house stood E. of the storm's center 45 rods, and the *débris* was carried to the NE. and N.

Mr. Wilson's heavy log house, one and a half stories high, and 15 by 30 feet, with a monster stone chimney on the W. end, occupied the center of the storm's track. It was partially lifted, then thrown to the ground, and finally carried away, piece by piece. There were thirteen persons in the house at the time, mostly small children, not one of whom received a serious injury. The storm is now in the midst of the heavy timber lining the banks of the Game Fork Creek, where it spread out nearly a mile in width, but the path of greatest destruction only averaged about 80 rods. The creek was first encountered where it made an abrupt bend to the NE. It flows from NW. to SE up to this point, when it bears 1¼ miles to the N. in making 1 mile to the E. Over his portion of its course the storm followed the stream closely. The eastern bank forms the highest bluffs in the surrounding county, rising abruptly over 200 feet, while the western side spreads out into a very fertile valley, one-fourth to one-half mile in width, and but slightly raised above the bed of the stream. Along the western border of the valley the surface gradually rises 60 to 80 feet to the high rolling prairie beyond. This valley, running to the NE. 1½ miles, opens into the still broader and more beautiful valley of the Big Blue, stretching out from N. to S. a distance of from 4 to 5 miles. That portion of this rich and fertile valley bounded on the S. by Game Fork Creek, on the N. and E. by the Big Blue River, and on the W. by a high "divide," formed the site of ill-fated Irving, a very pleasant and thriving village of 300 inhabitants. There were only three openings to this natural amphitheater (3 miles long by 2 miles wide), one from the SW. by way of Game Fork Creek, and the other two from the NW. and SE., by way of the Big Blue.

Going back to the funnel cloud where we left it at its entrance upon Game Fork Creek, we find that it followed the bed of the stream very closely, hugging the eastern bluffs with such tenacity that it ripped up nearly every tree along their sides and withered the tough prairie grass. Persons who watched its progress along this portion of its track stated that the demoniac fury of the cloud was appalling; whirling with most frightful rapidity, the intense black column would at times seem to level the whole bluff as it disappeared from view within the huge rolling mass of darkness. The eastern bank, covered with a luxuriant growth of timber, would, as the cloud moved along, successively emerge from its awful baptism swept clean to the soil. While this terrific manifestation of force was going on along the stream, westward over the valley, a distance of 60 rods, only a gentle wind was experienced.

The first house destroyed on the creek bottom was Mrs. Brumbell's, standing on the western bank, not more than 100 feet W. of the storm's center. All that was left of the building, 18 by 20 feet, and one and a half stories high, were five or six of the foundation stones and part of an old stove. The remainder of the house might have been found anywhere on the bluffs, valley, or about the village beyond.

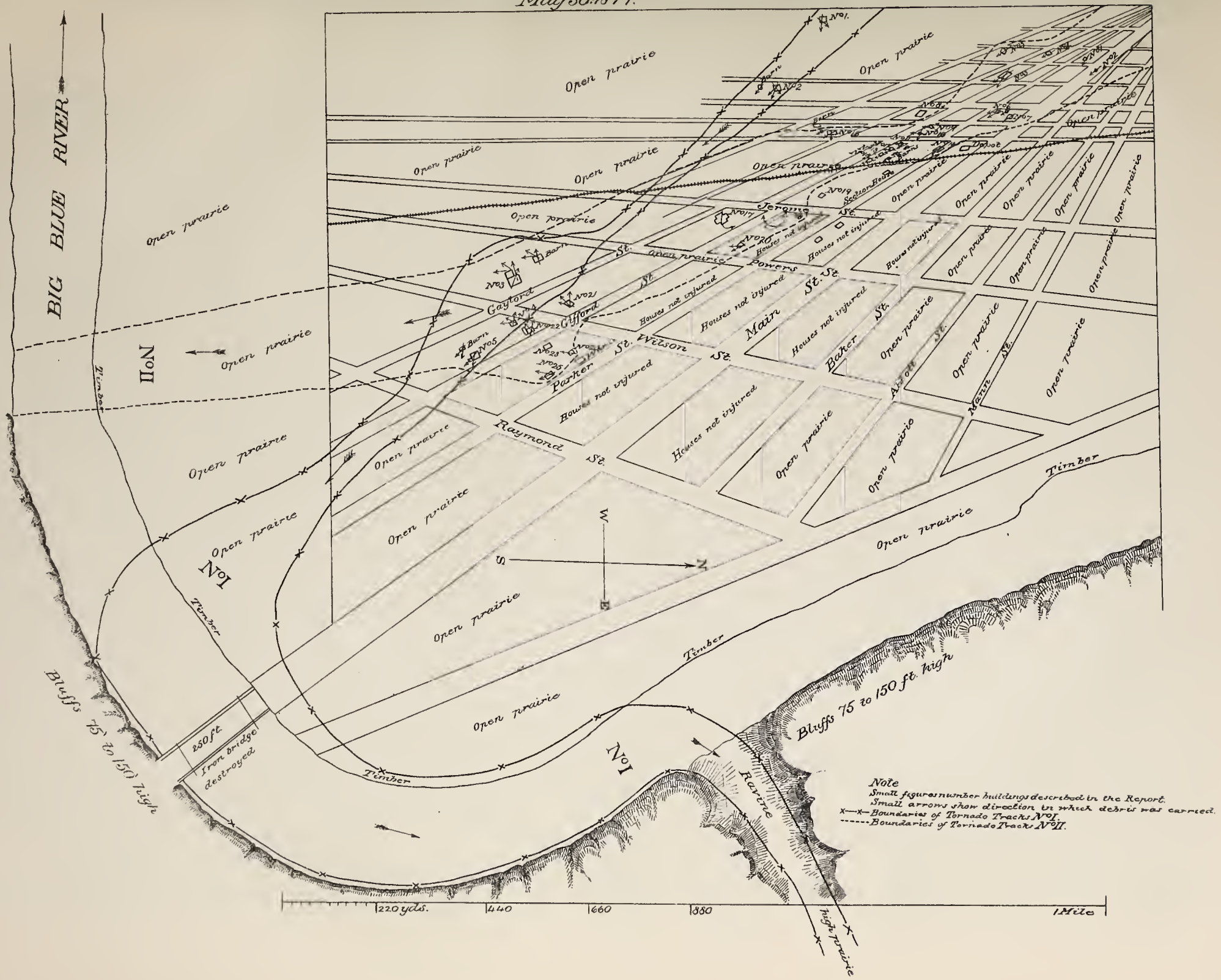
At the distance of a quarter of a mile to the NE, close to the western bank of the creek and in a little depression forming one of the irregularities of the creek's bank, stood the small house of Mr. Buckmaster; not one vestige remained to mark its former resting place. The *débris* was swept into the vortex to the E. and carried no one knew where. Of course it required but comparatively a small manifestation of force to destroy the frail building, as it was diminutive and loosely put together. But this condition made it all the worse for the ill-fated family within, consisting of the parents and four children. Mr. Buckmaster was left upon the ground near the foundation, with fragments of his pants and shirt hanging to him, and dangerously wounded. One of the girls was carried 30 rods to the E., another 40 rods to the S., another 25 rods to the NW., and the last, 35 rods to the NW. The mother was carried NE. 45 rods. Each one of the last five were found dead and perfectly devoid of clothing.

At this point the creek turns directly to the E, the high bluffs now forming the S. bank, and the cloud which had followed its course for 1½ miles while the creek ran to the NE., now left it at the SW. gateway to the town, and started across the flats for the latter, 1 mile to the NE. The first house encountered as it left the creek was the stone building of Mr. Ambrose Ship, standing 54 rods SE. of the storm's center. The building was unroofed and the *débris* carried to the NW. Directly opposite Mr. Ship's, to the W., stood the large stone house of Rev. Mr. Griffiths, Presbyterian minister at Irving. The kitchen on the W. side of the house was unroofed; the cupola and part of the roof of the main building were also carried away. The *débris* from the former lay to the SW. and SE., while that of the latter lay to the NE. The house stood on the extreme western edge of the storm's path, whose width was now about three-quarters of a mile. These two houses stood at the very entrance to the valley of the Game Fork, SW. of Irving. The funnel cloud narrowed its path of destruction about one-half after leaving this point. I will now commence to number the houses that were destroyed within the city limits of Irving in the order in which the storm severally met them. These numbers will also appear upon the map of the city accompanying this report. No. I, or that owned by Mr. John Gale, situated 20 rods NE. of Mr. Ship's, and about the same distance SE. of the storm's center, was unroofed and the walls torn down to the first story. The *débris* was carried to the NE. and N. It was a very old building and considerably out of repair. Mrs. Gale's baby was carried out of the house into a wheatfield to the NE., a distance of 30 rods, and a little girl carried E. into a small ravine, distant 28 rods. Four other members of the family, including the father and mother, were carried to the E. at distances varying from 10 to 15 rods, and their clothing torn into shreds and partially stripped from their bodies.

No. II, Mr. Gallop's house, stood within the path of the storm's center; size, 16 by 28, and one and a half stories high, with an addition to the S. 12 by 14 and one story high. The entire house was lifted up bodily, containing the family of five persons, to a height of about 20 feet above the ground, without so much as removing the chimney. It was then carried 125 feet to the NE., when it was twisted into pieces and the *débris* scattered to the ENE. and NW. The family came down to the ground upon the lower floor as it fell out, while the upper portion of the house was carried away above their heads. This was evidenced, aside from their own testimony, by the fact that most of their wounds were upon the scalp, or running from the neck over the head. The mother was carried into a cornfield 40 rods to the NE., two of the children 20 rods to the E., and the father and one child 15 rods to the NE. All were nearly stripped of their clothing and covered with black mud, but none killed. The cloud was now traversing the southern skirts of the town along the open flats, which course, had it been maintained, would have saved the trembling inhabitants and their valuable property from the terrible destruction soon to follow. Its course was ENE., sweeping along above the ground for a distance of 1½ miles, when the new and costly buildings (No. III) of Captain Armstrong were reached, standing a little W. of the storm's center. The house was a large two-story structure with mansard roof, and, with the barn, cost $9,000

Exhibit A.

Map of the Tracks of the Tornado's Nos. I. and II. through Irving, Marshall County, Kansas.
May 30th 1879.



Note
Small figures number buildings described in the Report.
Small arrows show direction in which debris was carried.
x—x—Boundaries of Tornado Tracks No I.
------Boundaries of Tornado Tracks No II.

The former was first struck by the wind from the NE. and turned completely over to the SW., when it was torn to pieces and the *débris* carried to the SE. and E. from one-fourth to three-fourths of a mile. The barn, 100 feet SW. of the house, was destroyed in a similar manner and in all probability by the same current, which continued its whirl to the left, as the *débris* of the house was carried to the S., SE., and E. A new and heavy lumber wagon loaded with 1,000 feet of lumber, standing half way between the house and barn, was carried away and no trace found of it. A new top buggy near by was completely wrecked, and portions of it scattered along the track for half a mile. Many were the curious freaks of the storm at this house, which space will not permit me to relate. Letters from Captain Armstrong were found on the farm of Mr. Frank Bard 7 miles to the NE. Lightning-rods and wire fencing were wound into balls or twisted into ropes. Tinware, cutlery, stove-pipes, harnesses, and furniture were broken and twisted in every conceivable manner. Not an article of value throughout the entire large house remained in a serviceable condition, or within 150 yards of the foundation. Everything was swept clean to the bare stone walls. Captain Armstrong estimates the time occupied in the destruction at not more than ten seconds; it was the result of years of careful saving and hard labor utterly annihilated in an instant.

The track now widened out to 80 rods, embracing the barn of Mr. W. J. Williams (No. IV), about 600 feet ENE. of Mr. Armstrong's house, escaping the former's residence by about 70 feet. The barn was torn down and the *débris* carried to the SW. and SE.

The house and barn of Mr. Thompson (No. V) were now reached, standing 35 rods NW. of the storm's center and 40 rods ENE. of the barn just destroyed. The roof and second story only of the house were carried away to the SW. and SE., leaving the first story upon the foundation, while the barn 65 feet to the S. was entirely demolished and the *débris* carried to the SE. and E. This was the last building destroyed in the town by what we will term the *first* Irving storm.

The funnel cloud now swept on a mile and a half over the valley beyond the town, scattering fences and twisting off small trees until it reached the Big Blue River at a point about 800 feet S. of the large iron bridge. In crossing the river the cloud struck the heavily wooded bluffs on the eastern bank, rising from 75 to 150 feet, and turned immediately up the river, striking the bridge squarely from the S., which it lifted bodily from two stone piers and one abutment and dashed into the river. So completely twisted into shapeless ruin was the huge mass of iron rods and stringers that it entirely disappeared from view in a few feet of water, except several ends of some of the long rods that reached out upon the shore. The superstructure rested upon a heavy stone abutment at the E. end and upon two stone piers rising 22 feet above the water, one in the center and the other at the western extremity of the first iron span. From this point to the western bank of the river, 140 feet, a wooden trestle-work completed the structure. Thirty feet of the eastern end of this trestle was carried away with the iron spans and deposited in the river. Where the wooden portion separated, timbers 10 to 15 inches square, fastened with heavy iron bolts, were broken asunder as if they had been but pipe-stems. The iron portion of the bridge consisted of two spans of 125 feet each, and four chords with a rise of 18 feet, weighing 27 tons to the chord. Several of the large iron rods 2½ inches in diameter, sticking out of the water upon the sandy beach, were found broken square in two. Smaller ones, and broad flat strips of iron, were twisted into fantastic shapes. So easily and yet completely was the great structure lifted from its foundation that but two of the top stones were moved from the eastern pier, and none, not even the mortar or cement, from the abutment and other pier. This was perhaps the most terrific manifestation of force recorded in any of the storms. The structure was built a few years since at a cost to the county of $20,000.

The cloud now passed up the river, following the bend to the N. and NW. for a distance of about 1,200 feet, when it reached a small "draw" from 250 to 300 feet wide, cutting up through the bluffs to the E. and reaching the high prairie beyond. Up this opening the cloud ascended with terrible fury, uprooting and breaking off large oaks and hickories 18 inches to 3 feet in diameter, and plowing up the earth in deep furrows. At the head of the "draw" and 265 feet E. from the line of steepest ascent, stood the house of Mr. J. C. Ward, occupied by his daughter and her family. Over this building the cloud raised, shaking it severely, but not overthrowing it. The doors and windows were blown open and out of the house, followed by the furniture and bedding,

and the rooms were filled with dense black smoke and flying *débris*. While passing up the river the cloud confined itself almost entirely within the opposite shores (varying in their width apart from 300 to 400 feet), reaching out occasionally into the timber on either side from 30 to 50 feet. As it left the bridge (so related a fisherman living upon the western bank, and in clear view of the whole scene) it backed up the water, exposing to view the bed of the stream in several places. Where the cloud left the river, shells and smoothly washed stones were found high up on the bluffs, which must have been brought from the river bottom. These shells and stones were picked up by Mr. J. C. Ward and other citizens of the town. George Wilson, a very intelligent little fellow of twelve summers, standing near his home in the eastern part of the town, three-fourths of a mile from the river, called to his father to come and see the water, as it was "way above the tree tops." The water must have been raised a considerable height in order to have been seen from the town, as the western bank was lined with a heavy growth of timber.

We have now finished the course of the *first* storm and only *true* tornado that visited Irving. The *second* storm, which came about one hour later, presented peculiarities not common to tornadoes, but a strange commixture of the straight hurricane and the whirlwind. After describing the destruction of the *second* storm, we will proceed to compare relative directions, velocities, appearances, and widths of the two storms.

Storm No. II came from the NW. down the valley of the Big Blue, another natural gateway leading into the broad valley surrounding the town. It will be found upon reference to the "Waterville Tornado" that a heavy westerly wind, doing considerable damage, prevailed at Waterville and Blue Springs, 8 miles to the NW., at about 6 p. m., just previous to the formation of the funnel cloud, several miles W. of the former place. This current passed eastward to Irving, reaching the town, after the first storm had disappeared on the high prairie beyond the river. In the wake of the first tornado a warm southerly current passed over the town, accompanied by rain. The sun now partially exposed beneath the heavy clouds lining the western horizon, threw its warm rays upon the terror-stricken inhabitants who, at this welcome invitation, assuring them as they thought, of peace and protection, emerged from their cellars and "dug-outs" to witness the destruction already committed and relieve their suffering neighbors. Hardly had the people recovered from the first shock, when there appeared in the W. a cloud of inky blackness and enormous dimensions, presenting a square front of apparently 2 miles in width and a perpendicular height from earth to sky. It moved along slowly, but with the most inconceivable majesty of force, apparently annihilating everything within its reach. No funnel-shaped cloud was noticed during its passage through the town, and but little commotion or tumbling of the clouds until it commenced its work of destruction, first, upon the farm of Mr. Preston, 1 mile NW. of the city, which it reached about 6.20 p. m. His buildings were only partially destroyed, as they were situated on the western edge of the storm, on a rise of ground above the valley, yet not upon the high prairie. From this point to the defenseless town there was nothing but a wide sweep of prairie grass. The town is now reached and as the awful cloud starts upon its frightful mission of death and destruction, it strikes into a cluster of eighteen houses and other buildings, within a radius of less than half a mile. Nearly all were swept to the earth in terrible ruin and the *débris* carried in one general direction eastward. The first houses encountered were those of Mr. George Bowdish and Mr. Johnson, No. I and No. II. The *débris* of the former was carried to the SE. and the latter to the E. The cloud now spread out to the S., embracing the seminary, No. III, and two small tenement houses, Nos. IV and V still farther to the S. and W. The latter were simply unroofed, the *débris* being carried to the E. The seminary, owned and conducted by Mr. Charles Preston, was a large stone structure two and a half stories high. It was first struck on the NW. corner, carrying away a portion of the roof and demolishing the S. and W. walls, the *débris* going to the SE. Says Mr. Preston:

> Our first sensations upon the contact of the storm were as though the building had been picked up, violently shaken, and then set down again. The next instant the doors and windows were broken in, the furniture whirled around the room and broken in pieces, and I, standing in the E. room, picked up, whirled around and carried through the folding doors into the main school room to the W., and laid upon the floor uninjured. The same instant the S. end of the building was carried away and most of the roof disappeared. Upon rising from the floor I found my clothing torn into shreds, but not a bruise upon my body. While in the act of taking hold of a door-knob to descend into the basement, where I had sent my family, I found both hands benumbed as though asleep, and I was unable to

open the door, while my wrists, elbows, and shoulder-blades felt more like the effects from the shock of a galvanic battery, yet no lightning was seen in the cloud or about it during its passage. During the passage of the storm electricity ran over the walls of my house, throwing off sparks like an emery wheel, but of a paler color; yet I would attribute this effect to the particles of sand and plaster blown from the walls by the extreme violence of the wind. While standing in the school-room, from the floor of which I had risen, I saw through the open doors and windows to the E. the flight of the storm. The cloud was of such intense blackness that I could not see anything of the buildings it would envelop, but as the milky mist passed away, which seemed to linger over the ruins, the terrible work was brought to light.

The frame houses of Messrs. Keeney and Jeffers, Nos. VI and VII, 80 rods NE. of the seminary, stood about in the center of the storm, and were completely destroyed. The former was lifted up, turned over, and torn to pieces, the *débris* being scattered to the E. and SE. The father, mother, and grandfather were carried to the ENE. about 200 yards, lying within a few feet of each other, and found dead. Mrs. Keeney was dashed head foremost into the soft ground up to her shoulders, entirely stripped of her clothing, and covered with black mud. The other two were partially stripped of their garments, and also covered with mud, which was fairly beaten into the clothes. Three little boys of Mr. Keeney's were blown in the same direction, but only about half the distance, partially divested of their clothing, and covered with mud, but not dangerously injured. The barn, W. of the house, was also destroyed, and carried along with the other *débris*. Mr. Jeffers's house was carried almost entirely to the E.

The house of Mr. Walker, No. VIII, banker at Irving, 50 rods S. of Mr. Keeney's, had the cupola carried away, and also a portion of the tin roof on the N. side. Size of the building, 36 by 40 feet, and two and a half stories high, very handsomely and strongly built. Heavy iron rods ran lengthwise of the building, connecting together the heavy oak sills; similar rods also passed through the sills into the heavy stone masonry below them, making the foundation doubly secure. The house, like several others, was built with a view to "weather" the hard "Kansas blows." On the approach of the storm the family descended below into the cellar, there to await the result. It first struck the W. end, which was lifted up so that objects outside could easily be seen. Then the whole building was raised up twice, from 12 to 14 inches each time. The building was considerably racked, and the threads torn from the bolts and rods as if they had been made of wood instead of wrought iron. The house was so well constructed, and being on the extreme southern edge of the storm's path, that it did not go to pieces. The barn, NW. of the house a few rods, was entirely demolished, and the *débris* carried to the E.

Northeast of Mr. Walker's, the large stone house of Mr. Buckout, No. IX, was next demolished. The walls were thrown into a shapeless heap, and the roof torn in fragments and carried to the SE. and E. No one occupied the house at the time.

Mr. Bates's house, No. X, a frame structure, was torn to pieces and the fragments scattered in two streaks to the NE. and SE. The family, consisting of the mother and four children, were thrown out upon the ground, severely bruised and lacerated.

In a line E. and W. with the two previously destroyed, but in the next square, stood the four houses of Messrs. Sabin, Sheldon, McClary, and Leddy, Nos. XI, XII, XIII, and XIV, directly in the storm's center. Here was the most fearful loss of life and limb, and the most complete annihilation of property. All of the buildings were frame, and the *débris* in each case was carried to the ESE. and E. Mr. Sabin's house, with the family in it, was lifted up and whirled around two or three times, which motion the occupants could easily feel, and then torn to pieces, the family being scattered out upon the ground and seriously injured. A hired man was carried from the house several rods, breaking his ribs and right forearm. Mr. Sheldon's house, standing next, was crushed to the earth and afterwards scattered in small fragments upon the prairie. Hardly any material was left to mark its former position. Both Mr. and Mrs. Sheldon were carried a considerable distance E. of the house, and very seriously injured. The latter was completely divested of clothing and covered with mud. Miss Emma Sheldon, a sister of Mr. Sheldon, and twenty-two years of age, was carried to the SE. about 200 yards, into a low, wet piece of ground. Nearly every bone in her body was broken, and the flesh in many places terribly lacerated by flying *débris*. The body was found perfectly nude and almost unrecognizable from the grass and mire beaten into it. Mr. Leddy's house, the last of the four, was inclosed by a grove of small cottonwoods and a picket fence. The building seems to have been lifted out of its surroundings, carried over the fence, to

the E., and then destroyed. The fence on the S. was not very badly wrecked, but on the E. side it was completely carried away. The trees were stripped of every portion of bark and foliage, looking as bare as bean-poles. Wound around their trunks and fluttering from the bare limbs were fragments of garments, strips of long prairie grass, and papers. On the picket fence hung shreds of every article of clothing common to the household, and within a radius of 30 to 40 rods lay portions of chairs, sofas, bedsteads, stoves, tinware, and crockery-ware, mingled with shingles, lath, studding, clapboards, sills, &c.

Fifty rods SSW. of these houses stood the house of Mr. James Warden, No. XV, another banker at Irving. It was vacant at the time. Size 30 by 36 feet, and two stories high, with a mansard roof. The kitchen attached to the S. end was 22 by 39 feet, and one story high. The main building was carried bodily from the foundation to the NNE. a distance of 15 feet, turned bottom side up and torn to pieces, and the *débris* scattered along the track to the NE. for half a mile. The kitchen was carried bodily from its foundation 30 feet to the ESE. and then dragged about 18 feet farther, the top crushed over to the E. and the E. side falling to the ground, where it remained unmoved. The E. half of the roof was carried E. and NE., for half a mile. An out-house 12 feet square, and standing S. of the kitchen 15 feet, was carried bodily 100 feet to the E. without being torn to pieces. An E. and W. board fence, 45 feet N. of the house was only blown down in portions, and that very irregularly, as if caused by the flying *débris* from the house. Fifty-one feet SW. of the kitchen stood the barn and shed, forming the extreme southern edge of the storm's path. Both buildings were entirely unharmed, except a few shingles taken from the roof of the former. A N. and S. board fence 100 feet W. of the house had but two panels broken down, and the outside cellar door over the W. foundation wall was not removed from its position. Small fruit trees S. and N. of the house, from 30 to 50 feet, were not the least injured. This building was said to be perhaps the strongest in the whole town. It was constructed with great care and at considerable expense, particular attention being paid to the frame and its supports, in view of the heavy winds common to this region of country

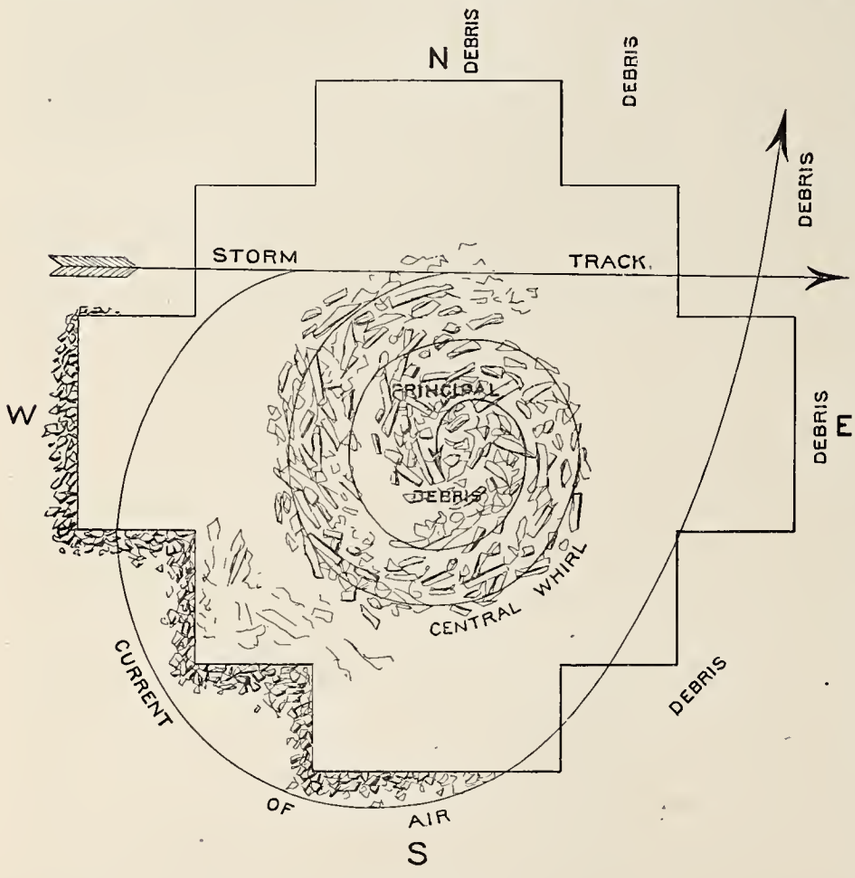


Diagram No. 3.

Directly N. of the storm's center 35 rods, stood the railroad company's elevator, No. XVI, which was the last building destroyed on that side; the depot, 350 feet still farther N., marked the extreme northern edge of the storm's path. The elevator was entirely demolished, and the *débris* carried to the E. across the railroad track. The depot was violently shaken, but not torn down. On the side track which ran along in front of the elevator to the E. stood several loaded freight cars, one directly in front, two on the S. end, and five or six on the N. end. The car in front of the elevator was turned over to the E., those on the S. end to the W., and two of those on the N. end, to the E.; the others remained standing. As the storm crossed the railroad track it narrowed down for about 200 feet, just missing the frail section-house, which stood nearly 600 feet due E. of

the elevator. A scantling 6 feet long and 2 by 4 inches was carried from the lumber yard N. of the depot, and sent crashing through the N. side of the section-house, falling inside upon the floor.

The storm now passed directly E. over an open square, for about 400 feet, to the school-house and church, Nos. XVII, XVIII, standing about 275 feet apart, the center passing between them. (Diagram No. 3.) The former was a very heavy stone structure, two and a half stories high, 50 by 30 feet, with a wing on the north side 22 by 30 feet, and of the same height. It was entirely demolished, the roof and walls being whirled into a cone-shaped mass upon the foundation. The walls were torn down within 2 to 4 feet of the ground. Heavy corner-stones, 18 by 36 inches, were whirled from their base and thrown into the center of the building. The roof a nearly all of the inside timbers lay crushed into splinters in the center. A portion of the latter were tipped over the walls to the NNE., but not thereby indicating any general forward movement of the wind, which throughout bore evidence in the *débris* of circular action. While the destruction was going on portions of the walls, S., E., and N. sides, were thrown outward from 10 to 20 feet, the *débris* going to the S., ENE., and N.; but on the W. side, which remained standing 2 feet higher than any other portion, no crumbled remains of the walls were found, the westerly current being of sufficient force to carry inward and over the foundation. Most of the *débris* was carried out to the ENE., in a direction from right to left. The bell, with frame attached (weighing 220 pounds), was carried from the center of the building 200 feet to the NW. Three ladies standing in the church-tower while the storm was passing saw the school-house when it went down, and stated that, as the storm struck it, it was enveloped in darkness and whirled around like a top, carrying the *débris* about with fearful velocity. Nothing was thrown outward from the cloud, and as it cleared away a pyramid of shapeless timbers and stones confirmed their anticipations of the manner of its destruction. The church went down at the same time, yet the roar of the storm was so great that the ladies did not know of the terrible destruction they had miraculously escaped in the demolition of the entire body of the church about them. The building was of limestone (same as the school-house), 60 by 40 feet, standing E. and W., with a tower on the SW. corner 60 feet high, upon a base 12 feet square, the latter continuing the same size for half its height and then tapering to the spire. (Diagram No. 4.) The wind first struck the building on the W. end, leaving 18 feet of the W. wall standing, but destroying the remainder of the building except the tower, whirling it around the latter by the N. and NE., carrying the roof, N. side, and E. end to the SE. and S., crushing to the ground the S. side. The *débris* was carried away from the foundation to the SW. The body of the tower was cracked, about in the center, and so wrenched that the doors and windows could not be opened. The spire and weather vane were bent to the SW., and the shingles on the former were torn off only on the W., N., and E. sides. The body of the spire seemed to be twisted from left to right, corresponding with the manner in which the *débris* of the building was carried. The tower did not form a part of the body of the church, but was built outside of, and attached to, the SW. corner, extending 12 feet S. of the S. side of the church. The W. side of the tower came flush with the W. end of the church, both presenting a surface of about 1,500 square feet to the wind. The full force of the current, however, only struck the W. end of the church, presenting a surface of about 1,200 square feet; but as the wall broke at the height of 18 feet above the ground, the impinging area was probably reduced to a surface of about 400 square feet.

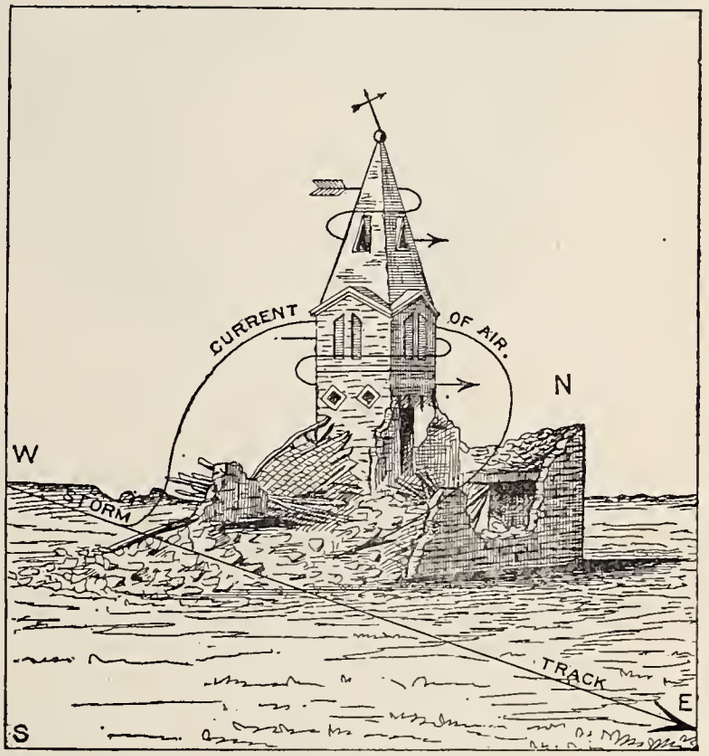


Diagram No. 4.

Captain Armstrong, who witnessed the approach of the storm at this point, stated that the dark cloud seemed to be formed of two wings, one on the N. and the other on the S. side, propelling the central body along by an alternate upward and downward movement towards the ground, first one wing descending and then the other in an awkward, flopping manner, whirling all objects in opposite directions inward towards the center. (Diagram No. 5.) This form and movement of the cloud would certainly seem to make apparent the peculiar destruction at the church and schoolhouse, both buildings being thrown in towards the center from the W., by the N. and S. points respectively. Not as in the true tornado was the *débris* on the two sides carried inward towards the center by the continuation of one circularly moving current from the E. by the N. and W. to the S., but in this instance two currents were acting upon the material from the same direction and on opposite sides of the storm's track, thus reversing the characteristic action of the tornado. The respective wings of the peculiarly shaped cloud could not have been over 50 feet in diameter, and possibly not that, especially in the case of the church, where the destruction was confined to a width of about 40 feet.

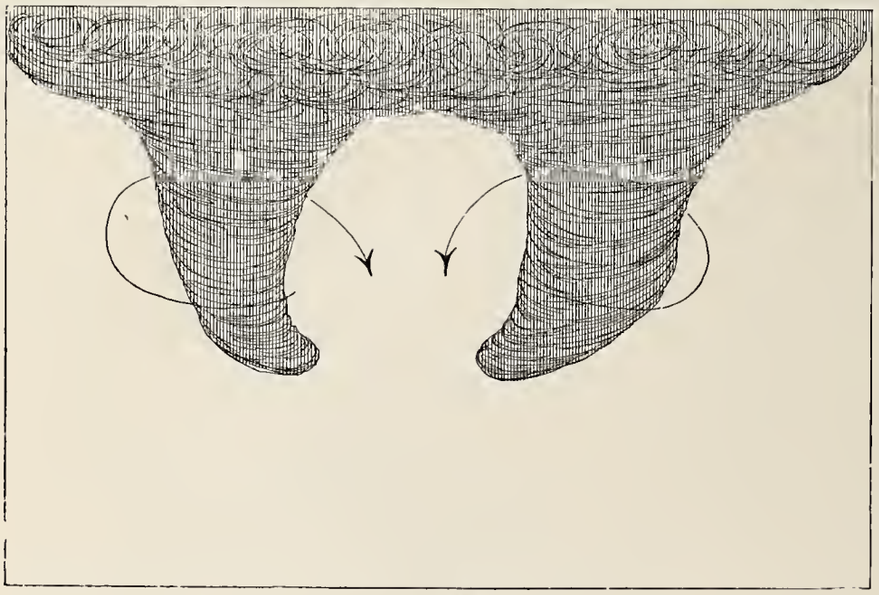


Diagram No. 5.

West of the church 160 feet stood a small tenement house, No. XIX, occupied by a family, which escaped injury in a very strange but interesting manner. The building was 12 by 16 feet, one and a half stories high and so loosely constructed that several men could have pushed it over without much difficulty. A portion of the bedding, clothing, and furniture were blown out of the doors and windows and the building violently shaken like a dog would take a rat.

Directly E. of the church 280 feet stood the house of Mr. James McCoy, No. XX, 14 by 20 feet, and one story high. It was lifted from the ground and carried 150 feet to the NE., breaking to pieces, when the *débris* was scattered to the E. and SE. The storm now spread out to the S. over the path of that traversed by No. I, and followed it for half a mile, but extending its path of destruction several hundred feet farther to the N.

After leaving Mr. McCoy's the storm passed over vacant lots for about one-fourth of a mile to the house of Mr. Griffin, No. XXI, which it carried entirely away, throwing the *débris* to the SE., S., and SW. Along a board fence 25 feet N. of the house, eight posts were pulled out of the ground from a depth of $2\frac{1}{2}$ feet and the remainder were stripped of the boards. Posts on the E. and W. side of the house were only divested of boards.

The house of Mr. W. J. Williams, No. XXII, 6 rods directly E. of Mr. Griffin's, was next destroyed. The main part running E. and W. was of stone, and the kitchen attached to the S. side was of wood. The NE. corner of the former was first struck by the wind, crushing in the E. end and then whirling the roof and walls around to the SW. and SE. The kitchen, in which were gathered several families, remained unharmed. Mrs. Williams, who, in search of her child, passed from the kitchen into the main part as the crash came, was found dead with the baby in her arms, the latter still alive and apparently uninjured. The picket fence W. of the house remained standing, except about 18 feet opposite the SW. corner of the house, which was partially torn down by the falling timbers. Out of a group of four shade trees standing at the N. side of the house only one, and that the smallest, was broken off, its top pointing to the SW. The others were partially stripped of their foliage, but not broken. On the S. side of the house four trees were uprooted,

three of them carried several rods to the SE., and one weighing about 600 pounds, with roots attached, was found three-fourths of a mile E. of the house. Trees standing in the corner between the kitchen on the E. and the main building on the N. were not damaged, except by those portions of the *débris* which fell against their trunks. One of the number rising considerably above its companions had its top badly whipped and broken. The destructive current here must have been very narrow, for the kitchen stood barely 30 feet S. of the N. corner of the main part, and the trees and fence on the N. side of the house 15 to 18 feet distant were not destroyed. The full force of the current could not have been over 45 feet wide.

The house of Mr. M. L. Cook, No. XXIII, a very small and hastily built structure, 110 feet NE. of Mr. Williams's, was entirely enveloped in dark smoke and violently shaken by a whirling current going from left to right, but it was not overturned.

The current seemed to be still stronger 350 feet to the NNE. of Mr. Cook's, at the house of Steven A. Bowdish, No. XXV, size 18 by 38 feet, and two stories high, which was carried bodily to the SE. a distance of 40 feet. The E. end struck the ground and the building was then turned over, torn to pieces, and the fragments scattered out upon the prairie to the E. and SE., three-quarters of a mile. Some portions were found on the high bluffs across the Big Blue, 3 miles to the E. At the same time the small barn of Mr. J. C. Ward, No. XXIV, standing 80 feet SW. of Mr. Bowdish's, was carried away to the SE.

Mr. Ward's house, No. XXVI, 100 feet N. of his barn, marked the northern edge of the storm's path in this section of the city. The house was severely shaken and battered with flying *débris* but not seriously injured. The storm has now reached the eastern skirts of the town and completed the last destruction within its limits. It left the track of No. I and passed with a much contracted form to the ESE. through the third natural gateway out of the plain upon which the town of Irving rests. For a distance of 2 miles over the naked flats it passed (almost entirely above the ground) filled with flying *débris* and accompanied with an awful roar. When it crossed the Big Blue about 60 rods S. of the course of the storm No. I, and near the mouth of Game Fork Creek, it cut a swath about 20 rods wide through the heavy timber for a distance of half a mile. The storm now struck the high prairie between the houses of Mrs. Cook and Mr. Boyd, about 1 mile apart, but causing no damage to either. Here the cloud broke up and all traces of its peculiar shape and whirling motion gradually disappeared, but a heavy storm of rain and hail continued across the prairie for several miles. Mr. Charles Preston, who was watching the disappearing cloud from his house in Irving, stated that upon reaching the high prairie it immediately changed its dense, dark color to a lighter gray, when its strange form vanished and the clouds scattered in several directions. People living 3 or 4 miles E. of this point knew nothing of the second storm, but experienced the effects of the first

Before proceeding with storm No. I, I will present several statements of persons who witnessed the approach of the two storms, also other matters of interest, particularly the relative time of appearance, &c.

Storm No. I crossed the railroad track after leaving Mr. Gallops's, at 5.35 p. m., railroad time, or 5.14 p. m., local time, according to the statements of several very reliable persons. The passenger train west, on the Central Branch of the Union Pacific was due at 5.25 p. m., Jefferson City time, which is 21 minutes faster than local time. The train stopped at the road-crossing before reaching the depot, and about in line with the center of the approaching storm, in doubt whether to proceed or not, as the terrible cloud could be seen some distance to the SW. coming down the creek. No one knew precisely how long the train waited, but thought it must have been five or six minutes. By the time the cloud reached Mr. Ship's house, 1⅞ miles SW. of the railroad track, the engineer and conductor doubtless felt more certain about the course it would pursue, as they proceeded rather slowly to the depot, a distance of 80 rods. The train had hardly arrived ere the storm cloud passed with terrible fury over the very spot it had vacated not two minutes before. Based upon the time above furnished, the progressive velocity of storm No. I was about 30 miles per hour. When storm No. II reached the depot the shaking of the building stopped the large regulator at exactly 6.45 p. m., and the agent's clock stopped at his house at 6.40 p. m. These clocks still remained undisturbed as the storm had left them, leaving no doubt as to the precision of the time. Storm No. I reached the railroad track at 5.35 p. m., and No. II at 6.45 p. m., but at

Sacred Heart Seminary

a point 80 rods to the NW., a difference in time of one hour and ten minutes. The relative width of the two storms are given as follows: When storm No. I was at Mr. Ship's it measured half a mile from E to W., but narrowed down to less than 40 rods at Mr. Gallops's. After leaving the latter's house the cloud lifted from the ground, descending at Captain Armstrong's, where it widened out to a quarter of a mile, again contracting until it reached the riverb eyond. Storm No. II, when it reached Mr. Preston's farm, was about 1½ miles in width, taking up a large portion of the valley. At the edge of the town, near Mr. Johnson's, its width was 1 mile. At Messrs. Walker's and Kenney's it was three-quarters of a mile. Between the depot on the N., and the barn of Mr. Warden, on the S., it had narrowed down to 125 rods; at the church and school-house to 1,360 feet. At Messrs. Griffin's and Williams's the storm widened out again to something over half a mile, contracting again after passing to the SE., so that at the river its path was about 400 feet.

As to the relative velocities of the two storms through the city, nothing can be said of greater importance than to repeat the general and harmonious statement that No. I moved most rapidly. Several reliable persons stated that it passed through the builded portion of the town, a distance of 1¼ miles, in one and one-half minutes; others said one and two minutes. In regard to storm No. II, the time is put at from two to three and one-half minutes. The following are portions of letters and verbal statements received concerning the peculiarities of the two storms. Mr. D. S. Giles, proprietor of the Irving Hotel, states that upon May 30, while returning from his farm in the country at 3.30 p. m., he experienced a moderate rain with a southerly wind. No rain before during the day, which had been quite sultry, with a continued alternation of clear and cloudy sky During the forenoon, while upon the high prairie, he felt an alternation of hot and cold currents of air in a manner which seemed very unusual. Soon after noon the clouds began to gather quite thickly in the W. and S., and succeeding the first rain the wind changed to the SW., W., and back again to the S., followed during the last wind by rain and a small quantity of hail. After the h il had nearly ceased, the strange, funnel-shaped cloud appeared in sight about 5 miles to the S . The upper part of the cloud appeared to be about the size of an ordinary barrel. It stood out clear and well-defined against a background of comparatively clear sky. As the cloud drew nearer and passed down Game Fork Creek, scud-like clouds from the N., S., and W., which shortly before seemed to be agitated by an unseen force, now dashed into the lower portion of the funnel, then up through its vortex and out at the top. Immediately after the cloud had passed through the city, perfect sheets of rain fell with a strong S. wind, the latter of sufficient force to nearly throw people from their feet. After the hardest precipitation ceased, the sun came out very beautifully for about fifteen minutes, but it was still considerably cloudy in the NNW. and SW., looking very much as if the entire storm had not passed. In about forty minutes an exceedingly dense black cloud appeared in the NW., 8 or 10 miles distant. Its darkness became intense with fearful rapidity, sending terror into the hearts of the bravest. People were trying to collect their wits and accustom themselves to the great calamity already befallen them, but upon the advent of this second monster all hope fled and the wildest terror reigned supreme. Many thought the millenium was surely at hand. The cloud was not ragged, irregular, or funnel-shaped, but presented a square and perpendicular front, moving steadily forward like the broadside of an immense mountain a mile in width, its summit lost in the impenetrable darkness above. The wind at Irving was from the SW., very strong, attended with lighter clouds of smoky appearance. When these two sets of clouds drew together, no funnel-shaped column was seen to descend, but there followed great commotion among them. The NW. cloud moved forward more rapidly, and for the first time the awful roar broke upon the ears of the terror-stricken people like the belching and bellowing of trains of artillery. The noise throughout the course of storm No. II far exceeded the first storm, although at the time the rumbling of No. I was considered deafening.

Mr. William Wells stated: "I live 6 miles SE. of Irving; was in a tornado on the plains of Nebraska in 1860. As soon as I saw this one, I said to my wife, 'It will tear everything to pieces that it touches.' At first it seemed to stand still, but soon hurried by. I could see it for a distance of from 25 to 30 miles. It took three quarters of an hour to travel that distance." This communication refers to storm No. 1. Mr. W. H. Checsman, of Irving, stated that he watched the second storm while forming. The cloud presented a heavy, solid, nearly square front, reaching

from the earth to the sky. Its form and movement were awe-inspiring, and quickly impressed one with the idea of inconceivable power and majesty. With its approach there came from the SW. hail and rain, the former small, but in large quantities. When the two clouds came together the precipitation ceased, and the NW. cloud moved rapidly forward (but not in funnel shape) with the most indescribable roar. After it had passed the city there followed from the W. the heaviest rain of the season (without hail), succeeded by a most painfully cold NW. wind, necessitating overcoats, and causing the wounded and dying to shiver and moan from its penetrating effects. No lightning was seen with either storm cloud. Dr. Chase, physician at Irving, stated that his attention was particularly directed to the shape and direction of motion of storm No. 1. The cloud tapered from top to bottom like an elephant's trunk and whirled invariably from right to left. He thought the wind during most of the day was from the E. and SE., attended with rather cool and pleasant weather until an hour or two before the first storm, when the air became very oppressive. The first rain and hail came with an ENE. wind about twenty minutes before the funnel came in sight. This statement does not really contradict that of Mr. Giles, who was stationed about 4 miles SW. of the city upon the high prairie, while Dr. Chase was in the extreme northeastern portion of the town where a current of air would be experienced moving toward the approaching storm. The hail was very large but scattering. After the funnel had passed over the bluffs to the E. an exceedingly heavy rain followed for about ten minutes, stopping as soon as the sun came out (others say it rained while the sun was shining). In about thirty minutes an intensely black cloud filled the western horizon, piled up layer upon layer in the most unusual manner, apparently from the earth to sky. As the cloud drew near to the city another very hard rain with some hail fell. While it was passing through the city a slight precipitation was experienced on the extreme edges of the cloud to the N. and S. About in the center of the black cloud a spot apparently 15 or 20 feet in diameter seemed much blacker than its surroundings. Within this small area a whirling motion was discerned, but no funnel-shaped mass was seen to descend such as witnessed in storm No. I. No thunder or lightning attended either cloud while within the range of vision, yet both were accompanied by rain and hail though not of unusual intensity.

Mr. Pumphrey, 3 miles due S. of Irving, upon the high bluffs overlooking the town, felt no influence of the storm at his place, but saw both of the clouds with equal clearness during their passage. There was a slight fall of hail at his house but none farther S. Mr. Morgan, 2½ miles N. of Irving, experienced quite a severe wind from SW. and W., unroofing a two-story log house and blowing down a few small trees. Hail fell in quite large quantities and extended about 1½ miles farther N. At the house of Mr. Strange, about 5 miles N. of Irving, there was no strong wind or hail. Taking into consideration these statements, we find the width of the hail storm to have been about 7 miles in this vicinity and 1 mile wider to the N. of Irving than to the S. The path of destructive winds was fully 1½ miles wider on the left than on the right side of the area of destruction through the town, caused by the direction taken and the large proportions of the second storm, whose center was at times one-fourth to one-half mile N. of No. I.

Mr. James Patterson, one of the most self-possessed men in the town during the passage of the storms, stated that while they were moving through the village there was experienced on their extreme edges an upward pressure, which acted so powerfully as to apparently reduce a man's weight about two-thirds. Small articles of every kind were observed rising from the ground from localities where no strong wind was felt, and finally drawn into the tornado cloud. It was necessary to hold your hat on, even when you felt no pressure against the side of your body. Shavings, straws, and other light objects would ascend in a straight line for a considerable distance and then all at once dart with lightning rapidity downward to the base of the funnel cloud, then upward through its vortex and out at the top. Nothing was seen to descend from the top through the funnel, but always ascended from the base, flying out in every direction from the top. In a similar manner did the light scud clouds, floating naturally about in the surrounding atmosphere until they came within the compass of the powerful suction, shoot downward on the outside of the funnel with inconceivable velocity, and then upward through the vortex. After the storm passed a downward pressure was directly experienced to such a degree that the rim of a slouch hat would fall down over the eyes, and small limbs upon the trees were noticed to bend downward. These

sensations were experienced by several other persons, but very few were out of their cellars and "dug-outs" to make these observations. Immediately after storm No. I passed, rain seemed to come in sheets on either side of the track, as if poured over from the edges of an overhanging cloud. It did not rain in the wake of the storm for some two minutes, until the clouds could gather, as it were, from each side.

Mr. D. T. Ward, of Irving, stated in a letter of July 2, in reply to several requests I had made about the distance heavy objects were carried, &c., as follows:

The tool-chest of Mr. J. H. Case, weighing 320 pounds with contents, stood by the S. side of his house (the latter W. of the storm center). It had remained upon the ground long enough to sink itself several inches into the soil. While the family were watching the approaching storm, and before its effects were felt upon the house, the tool-chest was observed to rise from the ground about 2 feet and move quite evenly to the SW. toward the storm, a distance of 35 feet, where it was deposited without disturbing the tools. A hand-car situated on the side track near the elevator was totally wrecked; two of the wheels with axle attached were carried 350 feet to the E. and nearly twisted off.

Mr. Frank Seaton, who was in Mr. Sabin's house at the time of the storm, was carried out of the top of the building after the roof was blown off and found 320 yards to the E. He and others who saw him say that he was carried at least 40 feet before landing for the first time; was taken up again but not so high, and partly carried and rolled about 100 yards, after which he became unconscious, and was lost sight of by those who were watching him. From the house of Mr. Gallops a piece of cottonwood window-frame was carried 100 yards to the E. and imbedded so firmly in an elm log that it could not be withdrawn. A great many portions of broken lumber-wagons and carriages had not been found up to the date of this letter, although miles of territory were traversed in their search. Heavy tires were found broken and twisted or straightened out like bar iron. North of Frankfort on the West Fork of the Vermillion River, where the storm crossed, a large stone, weighing from 600 to 800 pounds (partially raised out of the quarry on the W. side of the bluffs), was carried up to the top, a distance of 30 feet, and then rolled over the prairie for 350 feet.

Mr. Ward also stated that there were several instances where people were carried out at the tops of the houses after the roofs went off and before the building went to pieces; also cases where the sides and roof went together over the heads of the unfortunate inmates, who were left upon the ground floor where they received ugly scalp or back wounds. Mrs. Griffin's black-velvet bonnet with ostrich feathers was found 3 miles E. of the city upon the high prairie above the bluffs, torn, wet, and dirty. Mr. Keeney's pants, with pocket-book containing $1.60 and a note upon one of the business firms in the town, was found 2½ miles to the SE., on the farm of Mr. Day. A new rag carpet was taken from the floor of Mr. Keeney's house, and carried nearly half a mile to the SE. without tearing a seam. It was securely tacked down about the entire room. A window blind, recognized by its color, was carried from Captain Armstrong's house 5 miles to the NE. Letters and papers were also found in the same direction, a distance of 7 miles. A window-weight of 5 pounds was carried from the house 40 rods to the NE. and imbedded in the ground. Among the most wonderful freaks of the first storm was that displayed in the transportation of a cow belonging to Mr. Jasper Martin, whose house stood on the eastern edge of the storm's path, near Game Fork Creek. (Diagram No. 6.) By a very careful consideration of the circumstances attending the probable transportation of the cow, it was found that she was picketed near his house before the storm, but after it subsided she was noticed walking towards Mr. Casey's house on the N. side of the creek, having a portion of the lariat rope still upon her horns and her body in a dreadfully muddy condition. On tracing her track backwards about 100 rods down the creek to the NW. a point was reached where the tracks terminated in a full imprint of the beast in the plastic mud. From this spot the distance was measured back to the picket pin on the opposite side of the creek, covering nearly 140 rods. The growth of timber along the creek, averaging 30

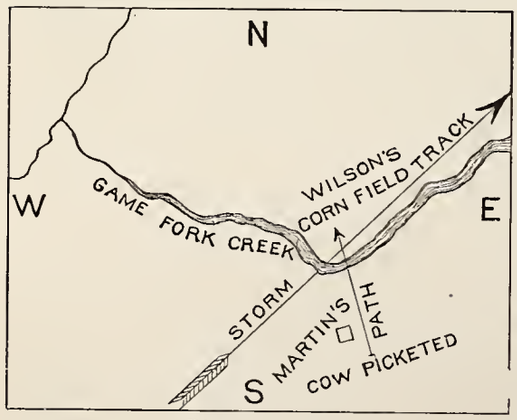


Diagram No. 6.

to 40 rods in width, was very heavy and almost impenetrable, making it impossible for the cow to have passed through it alive, so that the most rational conclusion to come to was, that she was carried over the tops of the trees, a height of from 30 to 60 feet (although perhaps not as high when the wind was blowing, bending down their tops), and landed in a cornfield, three-eighths of a mile to the NW.

Mr. Charles Preston stated, in a letter written at my request, that he was watching the second storm approach, from the roof of his seminary, about 6 p. m. Saw the storm, 10 or 12 miles to the NW. A huge and heavy mass of dark clouds lined the northern part of the western horizon, rapidly increasing in size and portentous appearance. In a few moments a lighter mass of clouds shot up from the SSW., while a similar action obtained in the N. These two clouds met at a point some distance SW. of Waterville, and at what appeared to have been about 1½ miles above the ground. They ran forward and wound round each other in a most fantastic but awful manner, as if in a death struggle to see who should gain the mastery. In a few seconds a large fragment was thrown off from the main mass in the shape of a cornucopia. This smaller cloud spun round and round with great rapidity like a top, and ran to the earth at an angle of about 45°, taking a NE. direction between Waterville and Blue Rapids. It was about one half mile wide at the top and tapered down to a few yards at the bottom. Its speed could be discerned much better than the main cloud moving to the SE. This "fragment" spoken of here is the "Waterville tornado," which is fully described elsewhere. The main cloud took the shape of a huge basket over 1½ miles wide and rounding off at the bottom. (Diagram No. 7.) All at once it made a sudden descent towards the earth, the lower part lengthening out and growing narrower, reaching the surface at an angle of about 45°. It now ceased the forward movement, and, standing upright on its narrow base, spun around like a top, throwing up angry jets of vapor through the vortex. As the cloud raised from the ground it swung over a little to the NW., and then gradually back on its course again, moving rapidly to the E., bounding over the hills, swinging first to the right and then to the left, then standing upright upon its base and again whirling violently for an instant. It now seemed to enlarge and fill up on the sides, pressing down to the earth until nothing but a broad, heavy, storm cloud appeared. In a few seconds another small neck ran down, resembling a funnel, but the huge mass of cloud was so near the earth that the column appeared to almost lie upon the ground, as it ran forward over the surface with lightning rapidity. The large cloud during this time was spitting out angry forks of dark smoke, which would dart and flash in every direction. They now disappeared again, leaving but the broad heavy cloud as before described. The storm had now reached Mr. Preston's farm near the city, enveloping it in a dense, milky mist, but the cloud was very dark near the top. Mr. Preston now came down from his place of observation to provide for the safety of his family. He further stated that for five or six days previous to the storm a warm S. wind had prevailed. On the afternoon of May 29 a stiff upper current was noticed by the action of the clouds to be passing southward, producing considerable commotion in the latter, throwing them backwards and upwards as if caused by contact with the warm southerly current moving at the surface. On Friday morning the opposing currents were still running rapidly, but accompanied with greater commotion in

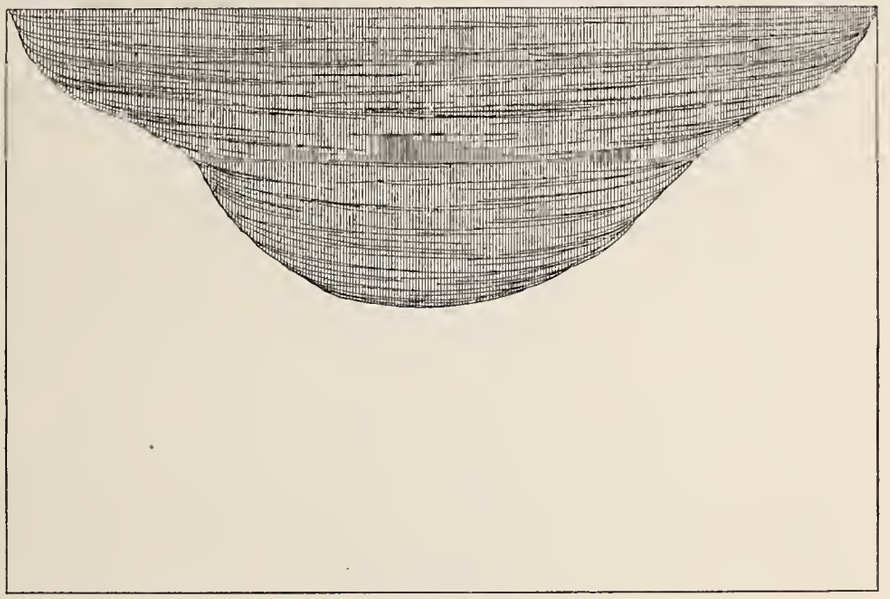


Diagram No. 7.

the clouds, especially in the afternoon, which now, instead of disappearing as before, began to thicken and concentrate in the SW. and NW. in a most threatening manner. The peculiar approach of this remarkable cloud, its strange manifestations, and its still stranger destructive effects, when considered in connection with the invariable accompaniments of the true tornado, will, I think, define its isolated position. Its incipient stages were attended with some of the characteristic attributes, but it lost them before its work commenced, resulting possibly from the peculiar condition of counteracting currents then violently confused by contemporary storms. This closes the analysis of the two storms at Irving, and we now resume our examination of storm No. I.

After reaching the high prairie beyond the Big Blue it passed to the NE. over the gently undulating surface of a region very thinly inhabited, a distance of 3½ miles to the house of Milo Wicks, on Corndodger Creek, a small stream running from NW. to SE. and emptying into the Black Vermillion. His building stood on the very edge of the stream, about the center of the storm's path, and 50 or 60 feet, on a gradual descent, below the surrounding level. House, barn, corn-crib, and farming implements were entirely destroyed and scattered over the prairie in the direction of the storm's course. The house of Mr. Riley Somers, 10 rods to the S. of the former residence, had the NW. corner of the roof taken off, but no other damage resulted. The cloud after crossing the intervening valley raised up a gradual ascent of 60 feet to the high prairie, where it moved above the ground, for a distance of 2 miles, when it reached a little ravine running from NW. to SE., like many others it had already passed over. Up this ravine the cloud moved a distance of 50 rods, demolishing the small house of Mr. Earl, drawing it inward to the storm's center and carrying the *débris* to the SW. and SE. Rising to the high prairie again, and passing on 3½ miles to the NE., it simply overturned the small house of Mr. Goodnight. Mr. David Webb's house, a few rods to the W., was moved from its foundation to the W., and the kitchen on the S. end turned completely over. For a distance of 1½ miles to the NE. the storm passed over a portion of the prairie which gradually descends to the banks of Johnson's Branch, a small stream running SE. into the Black Vermillion. Under the western bank and about 5 rods from the creek stood the small dwelling of Mr. Roper, which was entirely swept away, hardly leaving a vestige of the foundation. Fifteen rods to the NW., and a little higher than Mr. Roper's, stood the house of Mr. Caywood, on the W. side of the storm's center, which was thrown over and crushed in falling, but the *débris* was not carried away. On the opposite side of the track, and 10 rods SE. of the storm's center, the house of Mr. Fitch was turned over and torn to pieces, the *débris* being carried to the NE. and N. His young son was carried over the tree tops and the creek, a distance of a quarter of a mile to the NW., and landed unhurt. In crossing the creek the storm spread out to about 1 mile in width, destroying six small houses, scattered farther down the stream. The house of Mr. William Trosper, which stood as near the storm's center as that of Mr. Caywood's, but about 40 feet higher, was not touched. Rising upon the high prairie again, and pursuing its course to the NE., the storm threw over a small building, but not otherwise damaging it. The storm now reached the West Fork of the Vermillion, 3½ miles NW. of Frankfort, just above the mouth of Snipe Creek, where it destroyed the houses of Messrs. Fox, Ceasen, and Vaughn. The former was situated on the E. side of the storm's center in the creek bottom, where it was torn to pieces, and most of the *débris* carried to the N. and NW. The two latter were on the W. side of the storm's center, and the *débris* carried to the W. and SW. Mr. Vaughn's chickens were completely stripped of their feathers, some living through the ordeal, but most of them were killed and scattered over the prairie. Just before the tornado passed to the northward, a heavy storm of rain and hail passed over the city of Frankfort from the SW., damaging several small buildings, but committing nothing serious. No influence was felt from the tornado cloud, for at the place of its passage over the West Fork of the Vermillion, the path of destructive winds was not over 1½ miles wide. The storm now started up Snipe Creek through Rock Township to the NNE., sometimes keeping close to the creek, and then again bearing more to the N. on the high land, between the West Fork of the Vermillion and the two branches of Snipe Creek. The storm path over this section spread out to an unusual width, destroying houses in some portions of the track over 2½ miles apart, E. and W. Perhaps the most immediate cause for the storm thus embracing a larger extent of country was due to the fact that there were three large creeks running almost in the same direction to the NNE. within

less than 1 mile of each other, and all branching out from the same locality, viz, where the storm crossed the Vermillion. The ground between these creeks was not what you might call high prairie, as it was generally to a considerable degree below the level bounding the creeks to the E. and W. The first house encountered upon Snipe Creek was that of Mr. Henry Johnson, about 50 rods E. of the storm's center. The cloud was now moving northeastward one-quarter mile NW. of the creek. The building was entirely demolished, and the *débris* carried to the N. and NW. Mrs. Johnson was killed by the falling timbers. Mr. Waxtel's house, 100 rods to the NE., was partially destroyed and the *débris* carried more to the N. The residence of Mr. James Downs, one-quarter of a mile to the NE. but on higher ground, and still on the E. side of the storm's center, was utterly swept away, and Mr. and Mrs. Downs carried out upon the prairie to the NNE. several hundred yards, killing both. The buildings of Mr. Grove, 35 rods ENE., of Mr. Downs's, and on the western bank of the creek in the timber, were dreadfully demolished, and the *débris* scattered among the trees, and also to the N. and NW. over the bottoms. Mr. Grove was carried to the N. some distance from the house and killed.

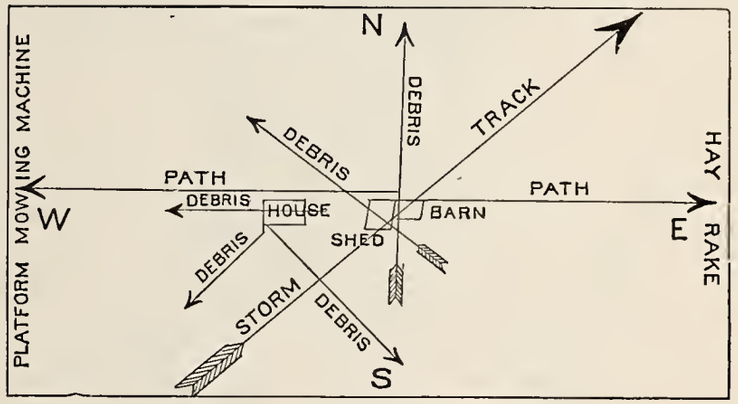


Diagram No. 8.

The house of Mr. Colwell, 70 rods to the N., was destroyed, and the *débris* carried to the NW. The houses of Messrs. Lane and Perry, the former to the N. 50 rods, and the latter nearly half a mile to the W., but still E. of the storm's center, were carried to the NE. One half mile directly N., the houses of Messrs. Vite and Conors were carried to the N. and NW. The storm had up to this point confined its destruction to the immediate boundaries of Snipe Creek, its center passing from one-quarter to one-half mile W. of it, along the bottoms, over sections 17 and 18, township 3 N., range 9 E. It now spread out to the West Fork of the Vermillion, about 1 mile farther, but with much diminished energy, which is shown by the fact that only the roofs were taken from the houses of Messrs. Cramer, Walker, and Foley in that vicinity. Between these houses and those of Charles and George Kieper and William Cassidy, destroyed within the storm's center, there stretches a broad tract of open prairie $1\frac{1}{4}$ miles in width, where no doubt the wind blew with great violence, but there was no material upon which to demonstrate its powerful force, and thereby leave evidence of its path. The barn of Mr. Cassidy, E. of the house, stood directly in the storm's center. The main part was carried to the N., torn to pieces, and scattered along the track for a mile. The shed was carried to the NW. and converted into kindling wood. The platform of a mowing-machine, together with a hay-rack, were lying in the barn quite near to each other. The former was carried three-quarters of a mile to the W., and the latter half a mile to the E. (Diagram No. 8.) The house, which stood about 200 feet W. of the barn, was torn to pieces and the *débris* carried to the WSW. and SE. E. of the houses occupied by Kieper brothers, and across Snipe Creek $1\frac{1}{4}$ miles, the house of Mr. James Bowman was destroyed and several of the family badly bruised. The destructive winds at this point extended $2\frac{1}{2}$ miles E. of the storm's center and $1\frac{1}{2}$ miles W. This width still continued for one tier of sections farther N., but with somewhat diminished energy.

In sections 9 and 10, along Snipe Creek, the following destructions occurred: The house of Mr. Schults, E. of the creek, in section 9, was unroofed and the *débris* carried to the NW. Mr. A. J. McGee's house, in section 9, half a mile farther N., and Mr. Henry Boatman's, in section 10, one-quarter of a mile to the E., were entirely destroyed, and the ruins carried to the NE. and N. and NW. In the NW. corner of section 8, and W. of the storm's center, Mr. Buffon's house was destroyed, and 1 mile farther W., in section 7, the houses of Messrs. Satterfield and S. S. Martin were only unroofed.

In the SW. corner of section 6, the stable of William Life was destroyed. In passing 1 mile farther to the N. the path of destruction diminished nearly as much in width. Leaving entirely the wide bottoms of the Vermillion, in order to preserve its NE. course, it confined its destruction hereafter to the east and west branches of Snipe Creek, and finally to the east branch alone, which ran more directly NE. On the west branch of Snipe Creek, the houses of Messrs. Bulkley and

White, standing E. of the storm's center, were demolished and the *débris* carried to the NE., N., and NW. The district school-house, 3 miles S. and 1 mile E. of Beattie, standing upon the high prairie between the east and west branches of the creek and E. of the storm's center, was a complete wreck, hardly a vestige of the building remaining near the foundation. The *débris* was scattered to the NE. and N.

One mile S. and half a mile E. of Beattie the storm reached the house of Mr. Leroy Sample, standing W. of the storm's center about 100 yards, on a rise of ground descending westward to the west branch of Snipe Creek. (Diagram No. 9.) The building was taken up bodily, except the ground floor, and carried to the SE. 5 rods, twisted to pieces, and the *débris* carried to the E., NE., and N., covering nearly a 40-acre field. Three members of the family, who were left upon the floor while the body of the house was carried over their heads, were considerably injured. Mr. Sample, jr., was carried several rods to the SW. and nearly stripped of his clothing. A stable, 20 rods SW. of the house, was blown to pieces and the *débris* carried to the SE. A round 5-pound weight was carried from the house 40 rods to the SE. One of the house sills, 6 by 8 inches and 10 feet long, was carried 120 rods to the SE. Two sulky cultivators, weighing several hundred pounds each, and standing 5 rods NE. of the barn, were carried into the creek 20 rods to the SW. A wagon box, 30 feet SE. of the barn, was carried 40 rods to the SE. and blown to pieces. A spring wagon, standing close by the house, was torn to pieces, and not a spoke left in any of the hubs, some of which were found over a mile to the E. A tin-type picture, 6 by 8 inches, was blown out of its frame which hung up in the house, carried 1½ miles to the NE., and found with one corner driven into an elm tree to the depth of half an inch. Mr. Sample stated that the weather had been very warm during the day, with rather a brisk southerly wind, which had been the prevailing direction for some time past. At about 3 p. m. a gentle rain set in with a SW. wind, continuing showery until the appearance of the tornado, which was about 6 p. m. About fifteen minutes before the tornado passed hail fell of very large size, but few in number. Both rain and hail ceased as the funnel-shaped cloud drew near, whirling in a fearful manner, and in a direction contrary to the hands of a watch. The wind first struck the house on the E. side and with the quickness and concussion of a cannon-shot, and bursting in the windows and doors. Then a calm ensued for a few seconds, when the wind came again with redoubled violence from the NW., taking the building from its foundations. After the hard wind commenced the rain again set in, accompanied with large quantities of hail. When the cloud had passed the precipitation entirely ceased for three or four minutes, when heavier rain and larger hail fell, with an easterly wind, changing ultimately to the W., followed by very cool weather, which continued throughout the night and succeeding day.

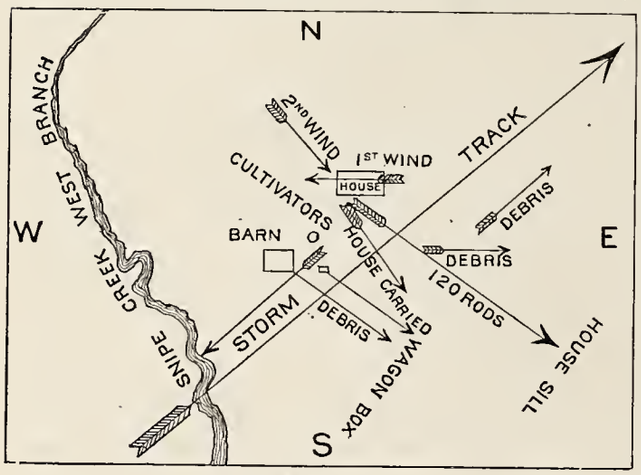


Diagram No. 9.

At the house of Mr. James Spiller, 2 miles SE. of Mr. Sample's, a 3-gallon tin pail with covered top and full of water was taken up and carried 45 rods to the NE. The pail was found right side up still containing the water, and the bail removed without injury to the ears of the pail. Mr. Spiller's house stood on the extreme eastern edge of the storm's path, escaping everything but a strong SE. wind, which committed no injury. One-half mile to the N., the storm ascended the high prairie in Guittard Township, ESE. of Beattie about 2 miles. Here it destroyed the houses of Messrs. White and Morgan. The path of destruction had now diminished to less than half a mile, but the storm retained the same degree of force. The house of Mr. Morgan stood nearly in the storm's center. The wind first struck it on the E. side, lifting it bodily to the W., off the foundation, when it disappeared out of sight in the dark boiling mass of whirling clouds. Mr. Morgan and family were in the cellar, and saw the house pass from over their heads in the manner above described. Most of the *débris* was carried to the NE. and N. During the storm's passage

up Snipe Creek, the timber along the banks, especially on the W. side was twisted and broken in a fearful manner for a distance of about 6 miles. Large elm, oak, cottonwood, sycamore, and other trees, from 2 to 3 feet in diameter, were wrenched from the earth as if they had been but bean poles. Thousands of cords of excellent timber were piled in promiscuous heaps, choking up the stream or obstructing roadways at the fords. At least one-third of the houses destroyed were new, having been erected in the spring, and not in all cases very substantially. The loss was exceedingly severe, and one hard to be borne by the "newcomers," under the peculiar circumstances, having just commenced to "break" the new prairie and prepare a scanty subsistence for the coming winter, and also the fact that there were no available sources from which to obtain lumber to rebuild. The storm now entered upon the high prairie, crossing it between Beattie, 3 miles to the W., and Axtell, 4½ miles to the E., leaving the heads of the two branches of Snipe Creek. Mr. Martin, an old resident of Beattie, a small town of 150 inhabitants, situated upon high ground overlooking the W. fork of the Vermillion, stated that about 6 p. m. on May 30, saw distinctly, to the eastward about 2½ miles, a strange-looking cloud, shaped like a cone and resting upon its apex. During his residence of twenty-five years, had never seen anything like it before. The lower portion of the cloud seemed to be thrown forward at an angle of about 45°. (Diagram No. 10.) At times, when it descended to the ground, it would straighten up and the smaller end would spread out to nearly the dimensions of the upper portion. The roar was distinctly heard, sounding like the rumbling of several trains of cars passing through a ravine. (Diagram No. 11.) During the day the weather had been quite warm, especially in the afternoon, when it seemed very hard to breathe comfortably. About forty minutes before the tornado appeared, rain commenced followed soon after by hail as large as hens' eggs. This precipitation was accompanied by a strong NW. wind, which came in gusts, the clouds moving towards the mouth of Snipe Creek, where other clouds could be seen moving from the SW. The SW. current seemed to be the stronger

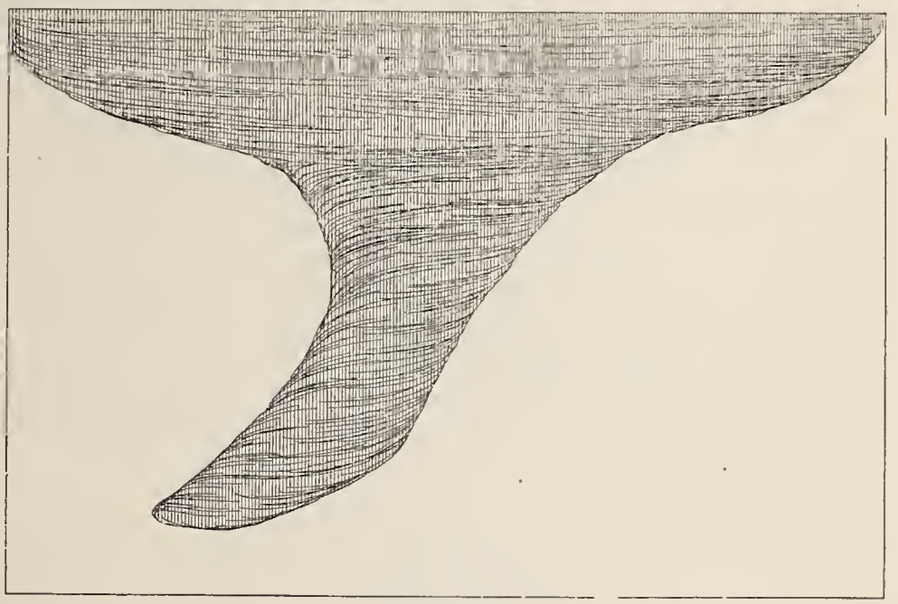


Diagram No. 10.

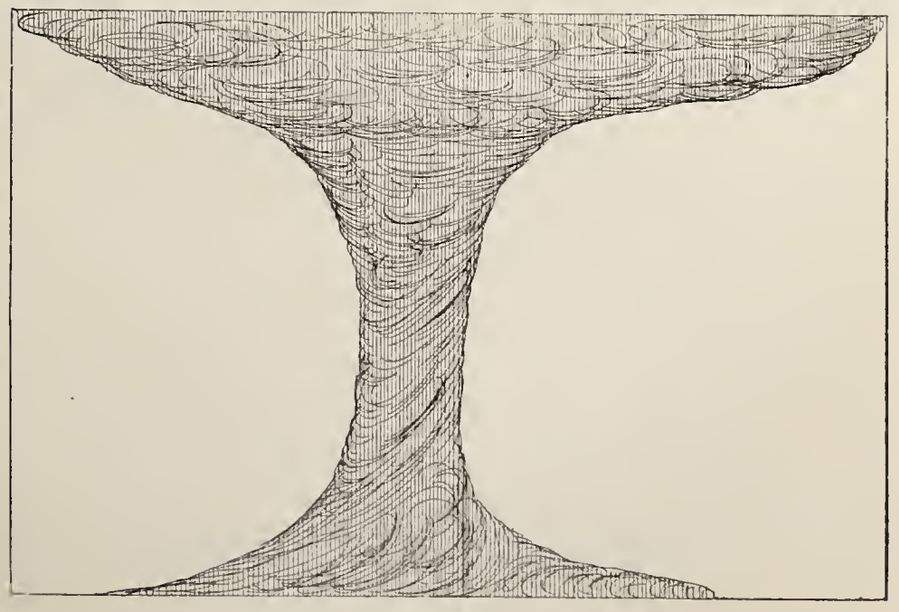


Diagram No. 11.

of the two, and to control and beat backward the clouds from the N. Finally they mixed together and shot off to the NE. with greater rapidity of motion. From that time, hardly five minutes intervened before the storm had passed Beattie, having traveled a distance of over 10 miles. Succeeding the storm, the wind changed to the W., and rain poured down in torrents, continuing with diminished energy, during the night and half the following day. During the evening and night it was very cold, necessitating overcoats for those who were rescuing the dead and wounded. In many instances the homeless sufferers were found huddled together over the ruins of their property, shivering with cold from the chilly, piercing current.

Mr. M. A. Tucker, proprietor of the Sherman House, Beattie, stated that on the afternoon of the 30th threatening clouds began to collect in the SW. and NW., with a brisk southerly wind. Rain commenced between 4 and 5 p. m., and at 6 p. m., while the tornado was passing, it was so dark (although the sun was still over one hour high) that it became necessary to light a lamp. The wind now changed to the NW. accompanied with very heavy rain and large hail, veering to the N. and backing to the W. again, when the hail ceased, but the rain continued at intervals through the night and part of the following day. At 7 p. m. the sun came out very bright for a few moments, lighting up beautifully the western horizon. This was the first good rain during the past eight months. All the rain that fell during the winter and spring would not have wet the ground 6 inches; in consequence the latter had become very dry and many were expecting a severe drought and loss of crops.

Mr. J. Brawner, of Axtell, stated that it was about 6 p. m. when the tornado passed to the westward of the town, where it could be distinctly seen. About 5 p. m. light rain commenced with a northerly wind (during the day the wind had been from the S.), ceasing a few minutes before the tornado passed. The wind now backed to the E., continuing steady for a few moments, when it veered to the SSW., W., and NW. as the storm cloud passed to the NE. Hail and rain now fell in large quantities, with a very strong wind for nearly one hour, accompanied by an unusual decline in the temperature. South of Axtell, which, like Beattie, stands upon the highest ground in the surrounding neigborhood, the wind from the NW. did considerable damage in the timber and blew down several houses. At the small town of Guittard, 4 miles N. of Beattie, no damage was done, although there occurred heavy rain with some hail and a strong NW. wind as the storm passed to the eastward. After crossing the Saint Jo and Denver City Railroad, between Beattie and Axtell, the cloud turned from NNE. to due NE., passing over a thinly inhabited region, for a distance of 11 miles. This portion of the country abounded in deep-wooded ravines and small streams, interspersed with rather narrow belts of rich, high, rolling prairie. During nearly the entire distance the cloud (preserving its characteristic shape), now descending, now rising and swaying from side to side as if suspended from an unseen hand, remained above the ground, committing no damage of any significance. This motion was visible for a distance of several miles on either side of its course. Five miles NE. of Beattie and 6 miles SW. of Saint Bridget, the cloud swooped down upon the small frame structure of Mr. Fuger, lifting it out of its inclosure of small cottonwood trees, carrying it over their tops (about 15 feet high), where, in falling, it crushed to pieces, and the *débris* was strewn along the storm's course for one fourth of a mile. This was the only damage to speak of, until Saint Bridget was reached. As the cloud passed over, or near to, some isolated settler, a loud rushing or roaring noise was heard, accompanied by a strong SW. wind, which at times was very severe, although the cloud did reach the ground. This violence of the SW. current was sufficiently attested by the large poles that were found placed against either side of the buildings to secure them upon their foundations, showing that in each case they had been badly shaken up. About 1 mile S. of Saint Bridget, the cloud passed over the broad belt of heavy timber lining the rather precipitous banks of Manly Creek, which ran eastward quite irregularly to Turkey Creek, in the adjoining county of Nemaha. It now descended upon the highest point of ground at the Catholic mission, destroying an old school house 50 rods SW. of the church. Brother Lambert, of the Order of Saint Benedict, and attached to this mission, stated that the storm passed about 6.30 p. m. It came up with a terrible roar and a basket-shaped cloud, whirling fearfully, and completely enveloping the place in darkness. (Diagram No. 12.) About twenty minutes before the tornado came, a light shower fell with a gentle northerly wind, which changed to the NE. as the storm cloud approached from the SW., blowing with considerable violence, but ceasing as the latter came

near, and by the time it had reached a point within one-fourth mile of the church, almost a dead calm ensued. After the tornado cloud passed by, a most violent wind succeeded it from the W., accompanied with torrents of rain and large hail. The change was frightfully sudden, severely wrenching the new frame parsonage, a strong two story and a half building, which must have been thrown over had it not been bolted down to its stone foundations, but only the chimneys were blown off. The cloud after passing over the hill to the NE. struck Willow Creek, half a mile to the N., a very small stream with broad bottoms, and running ESE., emptying into Manly Creek about 2½ miles E. of Saint Bridget. (Diagram No. 13.) On this creek, directly N. of the mission, the storm unroofed the house of Dennis Morian, carrying the *débris* to the E. Passing down Willow Creek to near its mouth, uprooting and twisting off the scanty timber in places, it left it, at the Nemaha County line, passing gradually up to the high prairie, over which it remained above the ground for about 1 mile, when it again struck Manly Creek where it bends to the NE. Here, on a slight rise of ground, but rather below the general level, it destroyed the log house of Mr. Corcoran. It now reached the bottom of the valley and crossed a portion of it which cut into the high prairie to the NW. Ascending the high ground which bounded this small inlet to the E., the storm destroyed the small stone house of Mr. Hickman, situated about half way up the southern slope of the hill. The *débris* in this instance and the former was carried along the storm's path to the NE. for from 50 to 80 rods. Passing over this high point of land which pushed out into the valley, the cloud again encountered the creek, keeping near its western bank and destroyed the timber in a fearful manner for a distance of about 2 miles, when it bore slowly to the N., leaving the creek which ran nearly due E. Its course now became ENE., as it ascended the high prairie where it demolished a school house in district 26, Clear Creek Township, Nemaha County. The building stood on the N. side of the storm's center and fronted the S. It was first struck on the S. end, bursting in the door and carrying the building off the foundation 60 feet to the N., where it went to pieces and the *débris* scattered to the NE. and E.

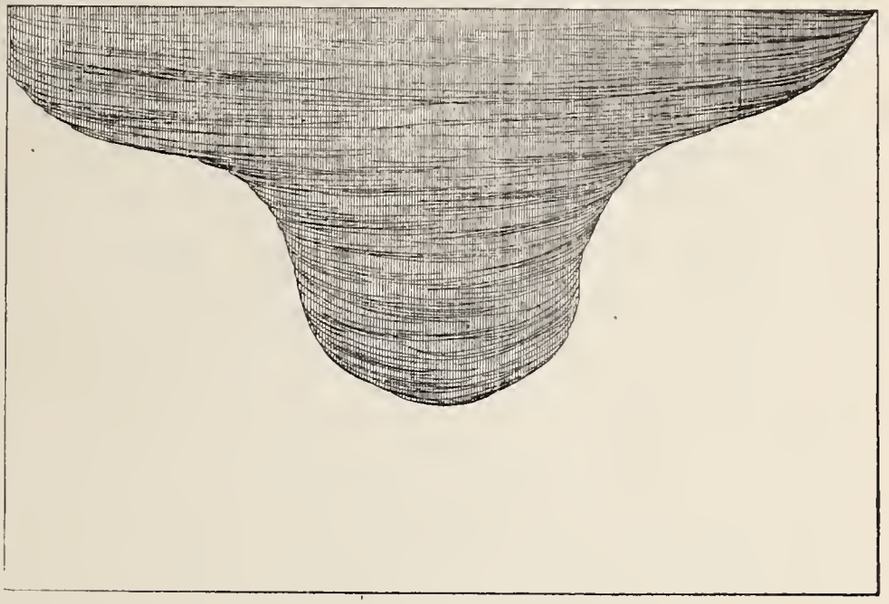


Diagram No. 12.

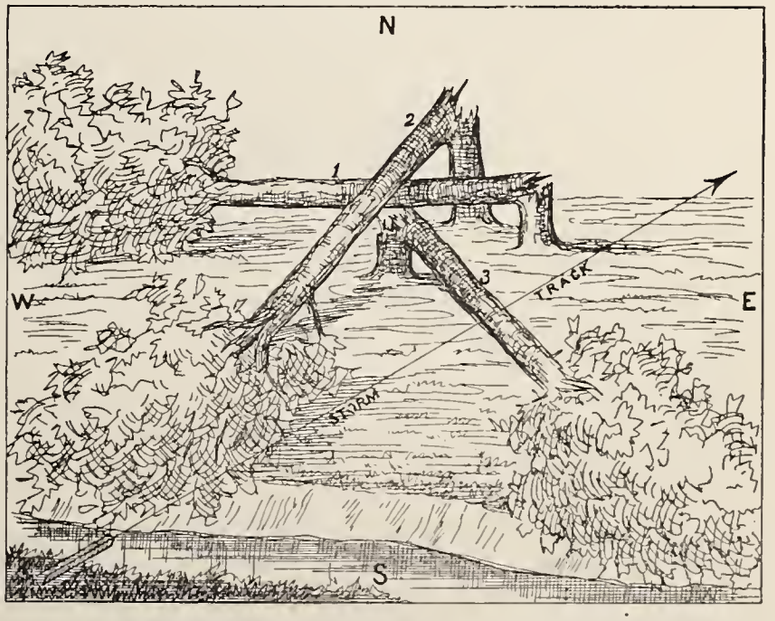


Diagram No. 13.

One-quarter of a mile to the E. the large stone house of Mr. McCaffrey was unroofed, and several of his outbuildings demolished. Part of the roof was deposited a few rods E. of the house,

but the largest portion had not been seen since the storm, though vigilant search in every direction had been made for it. Large cottonwood trees from 12 to 18 inches in diameter, standing a few yards E. and SE. of the house, were broken off from 8 to 15 feet above the ground. The width of the storm track at this point was about 300 yards. The storm passed at about 6.45 p. m., after which the sun came out quite pleasantly, but the air was very chilly, with a strong westerly wind prevailing. It rained very heavily after 7 p. m., with a NW. wind, and at intervals through the night. The following day was fair, but very cool. Mr. McCaffrey's house stood one-quarter of a mile W. of Turkey Creek and three-quarters of a mile N. of Manly Creek, upon a considerable rise of ground sloping to the SE. The latter creek empties into the former at this point, and both pass into clear creek 1½ miles to the SE., which empties into the Nemaha River 5½ miles to the E. In crossing Turkey Creek to the NE. five small buildings, situated along the creek bottom, were unroofed and partially demolished. The heavy timber for a width of half a mile N. and S. was torn and twisted in the usual manner. Directly E. of McCaffrey's the eastern banks of the creek were very precipitous, but about 80 rods farther to the N. a little ravine 150 yards wide cut up through the bluffs to the high prairie beyond. Up this "draw" the storm cloud passed with the utmost display of violence, tearing up and breaking off nearly every tree and bush throughout its extent.

Half a mile from the top of the bluffs and on still higher ground the storm unroofed the small house of Mr. Gopelt, a German farmer. The cloud now rose entirely from the ground, and passed over the high "divide" between Turkey Creek and the Nemaha River for a distance of 6 miles, crossing the latter where it passed the Nebraska line, 1½ miles S. of Cincinnati, a small town in the extreme SE. corner of Pawnee County, Nebraska. During this part of its course no damage was committed so far as careful examination could reveal. Over the many little wooded ravines which it passed there was not the slightest evidence of its destructive energy, but a strong SW. wind followed in its wake, succeeded by heavy rain and in some cases hail, with a cold westerly wind. Dr. A. H. Jackson, of Cincinnati, stated that the storm passed between 1 and 2 miles S. of the town at 7 p. m., or perhaps a few minutes later. During the day the wind had been mostly from the SE., but very changeable, as well as the clouds, which sometimes covered the zenith and portions of the horizon, and then entirely disappeared. It was very warm, especially in the afternoon. About 4 p. m., the clouds began to gather thickly and threatening in the W. and looked very peculiar, sometimes red, changing alternately to muddy, grayish blue and black. After this series of changes had been going on for some time, small scud clouds were seen to break off from the larger masses and move rapidly about each other, finally concentrating in the SW., the wind at the surface being still from the SE. In the course of a few minutes the wind entirely ceased, followed by a short period of calm, when, upon looking again to the SW., distant about 3 miles, a peculiar barrel-shaped cloud of a dirty smoky color was seen rather high up in the air. The wind now sprang up very strong from the SW., and the cloud passed by to the S., disappearing from view in the heavy timber along the Nemaha River, which it tore up badly on the property of Mr. J. P. Cone for a width of 240 yards. While the tornado was passing the wind changed suddenly to the NW. and blew very violently for from ten to fifteen minutes, whipping off the tops of some of the trees in the town and overturning several rods of fence. The wind was accompanied with heavy rain and some hail, but it ceased with the decline of the heavy wind, and no more fell during the evening or night.

The clouds seemed to break away and clear up in the W., but a very cool westerly wind continued, even through the following day—a very unusual occurrence for this time of the year. The storm cloud again lifted from the earth while upon the high prairie E. of the Nemaha River, and passed over the southwestern portion of Richardson County, Nebraska, to the small town of Dawson's Mills, on the Nebraska and Atchison Railroad. During this portion of its course, about 20 miles in length, it left scarcely any evidence of its destructive power, except while again crossing the southern branch of the Nemaha, where it bends to the NW., and about half way between the towns of Athens and Salem. The timber was twisted and broken in considerable quantities, sufficient, at least, to unquestionably decide the work as the result of the tornado's characteristic whirl. The track was comparatively narrow, and the destruction mostly confined to the tree tops, especially on the western bank, where its work first commenced. The cloud might have reached

the earth in several places previous to its crossing the river, but no evidence from any source could be obtained of such a fact, principally because no portion of the storm's entire path was so completely devoid of creeks, timber, and habitations. The entire distance from Cincinnati northeastward to the NW. bend of the Nemaha, about 12 miles, was a bare prairie, offering nothing but a monotonous surface of grass, yet not by any means level, as it was perhaps the most abruptly undulating of any portion of the whole track. The remaining portion of its course lay over the high divide between the south branch of the Nemaha and the main river, which runs from NW. to SE., through the southeastern portion of Richardson County, and empties into the Missouri. On the eastern bank of the Nemaha, and at the foot of high bluffs surrounding it on the W., N., and E., stood the town of Dawson's Mills, the last village encountered in the track of the storm. Michael Riley, the principal merchant of the place, stated that the storm reached them about 7.10 p. m. There had been no rain during the day until about ten minutes before the storm cloud came upon them. The rain was accompanied with hail of very large size, but scattering. The tornado came up from the SW., over the bluffs along the river, looking like a waterspout, and attended with great commotion in its interior, and a loud, roaring noise. As it passed, a strong current from the SW. crushed in the front of the store and tore down all the shelving on the N. side. Mr. Mead, another merchant at Dawson's Mills, stated that during the day the wind had been from the SE., and the weather was very pleasant until just at evening, when it clouded up a little with a SW. wind. About thirty minutes before the storm, dark, threatening clouds began to appear in the SW. and N., gradually approaching each other until covering the western horizon. The two seemed to join in the NW., when there resulted a great commotion in the clouds, some moving one way and some another. The entire operation was not distinctly visible, as the observer was too low down behind the western hills to watch all of the changes. A great roaring was now heard, like the rumbling of several trains of cars, while the wind was still from the SW. As the roaring became louder, indicating the approach of the storm, a peculiar cloud, shaped like a waterspout, made its appearance. The wind now commenced to lull, and soon a calm ensued, as on the eve of some awful catastrophe, which filled the inhabitants with terror. It had now become so dark that few things could be distinguished. The cloud did not dip down into the valley, as was expected, but moved over the bluffs to the N. of the town, distant about 1 mile. From all appearances it had hardly passed ere a violent wind sprang up from the NW., accompanied with a few large hail stones and rather heavy rain, which dashed down the bluffs and through the valley, committing considerable destruction. The NW. current slacked up a little in a few seconds, when it was succeeded by an equally violent wind from the N., the rain continuing. The wind gradually veered to the W., with a much lower temperature, producing a chilling effect upon the atmosphere for the next forty-eight hours. The rain continued until about 10 p. m., when all was quiet, commencing again with a westerly wind shortly before morning. The Catholic church, 26 by 50 feet, with 16-foot studding, was lifted bodily from the foundation and carried to the SE., the SE. corner 10 feet, and the NE. corner 14 feet. After striking the ground, the building moved 6 feet to the S., plowing up the surface to a depth of several feet, when it fell to pieces. There were at the time about fifty persons in the church, in attendance at evening meeting; none were killed, but several seriously injured; most of the people sought protection under the seats, upon which the *débris* fell, thus saving many from a painful death. One piece of flooring 12 feet long and 6 inches wide was carried 120 yards to the SE., and considerably lighter *débris* was carried 150 yards in the same direction, and deposited in the garden of Mr. Webb. The wagon-shop of Mr. S. C. Barlow, 18 by 40 feet, and two stories high, with an addition to the S. 12 by 20 feet, had its E. end moved 18 inches to the S., but the W. end remained firm. His stable, a few rods W. of the shop, 12 by 17 feet, and 9 feet high, was picked up and blown entirely through two board fences, about 60 feet apart and five boards high, tearing them down for a width of 25 feet. The barn contained 1½ tons of hay, which was pretty thoroughly scattered about the town.

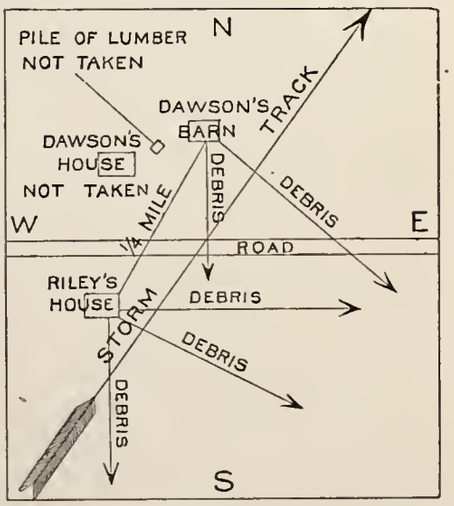


Diagram No. 14.

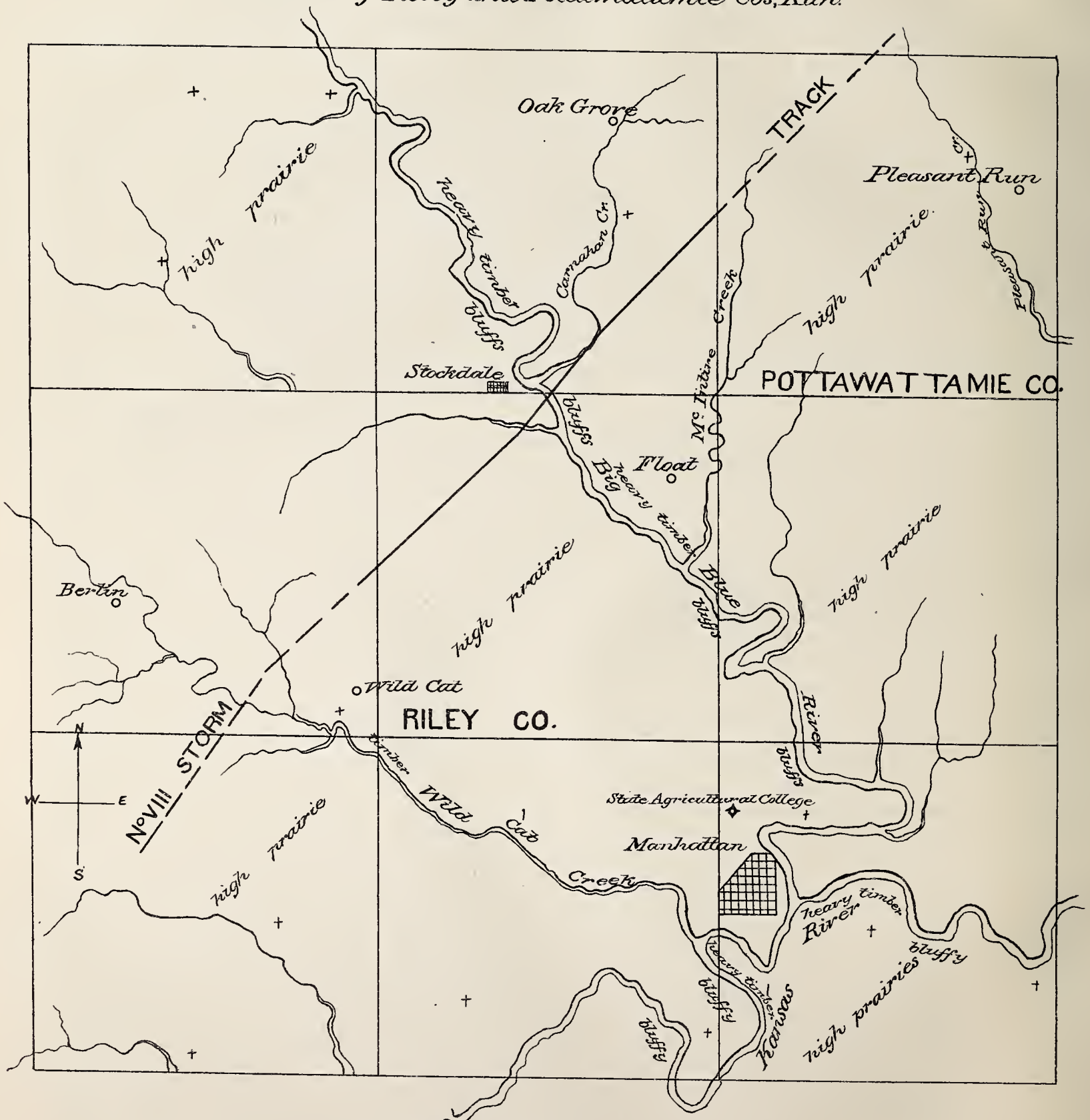
Upon the prairie above the town, which formed the high divide between the Muddy and the Nemaha rivers, the house of Mr. Riley and the barn of Mr. Dawson were entirely destroyed. Here the tornado performed its characteristic work. (Diagram No. 14.) The house stood about 200 feet W. of the storm's center, and was very solidly constructed of oak sills and studding. The wind struck it first from the NW., moving it from its foundation and then tearing it to pieces, scattering the *débris* to the S., SE., and E., some parts being found half a mile distant. Only about one-third of the flooring could be found at all. Two of the house sills, 10 by 12 inches and 16 feet long, were carried, one to the S. 200 yards and the other 300 yards to the SE. One-fourth of a mile in a direct line to the NNE. stood the barn of Mr. Dawson, a large and firmly-built structure 30 feet square with 16-foot posts. It was torn to pieces on the foundation, the wind striking it broadside from the W., crushing in the heavy oaken frame as if it had been a toy shop, and scattering the *débris* to the S. and SE. Two of the sills, 14 inches square and 30 feet long, were found 23 yards to the SE. A pile of loose lumber, 50 feet WSW. of the barn, was not harmed; also the house, 300 feet in the same direction, escaped. Grass, hay, weeds, pieces of furniture, clothing, and boards were scattered along the storm's path for a mile or more. This constituted the last destructive act of the true tornado, so far as any reliable information could be obtained. Nothing was seen or heard of further on, in the way of a peculiarly-shaped cloud or of any destruction where a whirling current or cloud became a factor. Of course, by the time the tornado reached Dawson's Mills it was very nearly sundown, and any observation upon the movement or appearance of the cloud would be attended with much difficulty, especially as it was now moving above the ground, and therefore much diminished in size.

Rev. J. W. Taylor, an itinerant Methodist minister at Saint Deroin, 18 miles due NE. of Dawson's Mills, and on the Nebraska side of the Missouri River, stated that in his travels to and fro between these points he had found only one instance of destructive action (a farmer's house), which occurred in the vicinity of Baraday, a small village 6 miles SW. of Saint Deroin. The building, situated in a small "draw" up which the storm evidently passed, was completely destroyed, together with all of the outbuildings. The house was very well built, being much stronger than the buildings of most of his neighbors, which were perfectly unharmed, though not a quarter of a mile distant on the high prairie. The family, consisting of four, were in the house at the time, but none were seriously injured save the father. The broken furniture, parts of bedding, clothing, boards, and shingles were strewn along the track to the SE. and E. for a distance of from one-half to three-fourths of a mile. The time of this destruction was given as 7.30 p. m., which would agree very well with the time at Dawson's Mills of 7.10 p. m., making the progressive velocity of the storm between these two points (supposing this destruction to have been caused by the tornado) at about 36 miles per hour, rather above the average velocity for the whole storm track, but not at all excessive for small portions. As no one mentioned to Mr. Taylor in connection with this destruction anything about a tornado, and as no questions were put by him respecting the possibility or nature of such a storm, we are left somewhat in doubt concerning the course and conditions of the tornado after leaving Dawson's Mills. At Saint Deroin, as stated by Mr. Taylor, there was no severe storm of wind during the day, but an exceedingly heavy fall of rain, mixed with some hail, which came from the NW. between 7 and 8 p. m. No damage was committed. Thought that the heaviest part of the storm went W. of him. It was clearly determined by the unanimous testimony of many people, and a considerable amount of destruction, that a very heavy NW. storm of wind and rain, but not much hail, prevailed between the hours of 7 and 9 p. m. over the eastern portion of Richardson County, Nebraska, the southwestern part of Iowa, and the northwestern part of Missouri. Now, it is more than likely, from the coincidence of time and place, that the tornado finally lost its identity in this heavy storm, which had come many miles from the NW., in Iowa and Nebraska, crossing the path of the tornado E. of Dawson's Mills. But notwithstanding what may be thought or said, it is an indisputable fact that the identity of the tornado was extinguished where the NW. storm began its work. I obtained no reports of any NW. storm W. of Dawson's Mills, but its track seemed to be confined to the sections E. of the Nemaha River.

On the farm of Mr. John J. Hart, 2½ miles SE. of Dawson's Mills, and between 7 and 8 p. m., a large stable, 36 by 40 feet, and containing eight horses, was blown to pieces by a heavy NW. wind. The house of Mr. James Harrison, 1¾ miles SSE. of Dawson's Mills, was completely demol-

Exhibit A.

Map of the Track of the "Stockdale Tornado"
Portions of Riley and Pottawattamie Co's, Kan.



Average width of bottoms, from ½ to 2 miles.
Timber Belts, ¼ mile.

ished about the same time, a heavy NW. wind prevailing, accompanied with rain and hail. Three and a half miles to the SE., the house of Mr. John Fisher had the doors and windows blown in, from the NW.; the wind was attended with rain and hail and lasted for about twenty minutes.

Mr. D. W. Easley, of Humboldt, a small town 8 miles NW. of Dawson's Mills, reported a very heavy NW. wind with torrents of rain, but not much hail, as occurring between the hours of 7 and 8 p. m. and lasting about thirty minutes. It was accompanied with an unusual display of thunder and lightning. Several small outbuildings and chimneys were blown down, and a new drug store badly racked Had had no rain before for several weeks, during which time the wind had been southerly and most of the time very brisk.

Mr. M. O'Brien, of Falls City, about 14 miles SE. of Dawson's Mills, reported a strong NW. wind with very heavy rain and small hail about 7.30 p. m. Two small houses were moved from their foundations and several outbuildings were blown over. The house of Henry Shaw, 7 miles N. of the town, was completely wrecked by the same storm. This storm also visited the town of Craig, just across the Missouri River, in the northwestern part of Nodaway County, Missouri, at about 7.30 p. m., and still later the southern portions of Nodaway, Holt, and Andrew Counties. Mr. Fred. Meyers, of Craig, reported that a heavy NW. storm visited that place at the time above given. Very heavy, dark clouds began to gather in the N. and NW. rather early in the afternoon, and between 6 and 7 p. m. other threatening clouds appeared in the SW., apparently moving up the Missouri River. As they swung around to the NW. the two sets of clouds apparently joined, resulting in an unusual commotion and wrestling of the opposing forces, when the wind suddenly veered from the S., where it had been during most of the day, successively to the W., NW., and N., blowing with great violence from all the points. It was accompanied with exceedingly heavy rain, thunder and lightning, and some hail. From forty to fifty chimneys were demolished, the front of a large drug store blown out, and the building itself (24 by 100 feet) was careened over to the S. and E. A photograph car was turned over several times, and a large and costly wind-mill, belonging to the railroad company, completely destroyed. A "Woods harvester" weighing about 1,200 pounds was moved along the ground for 80 yards to the SE. The storm, after leaving the town, passed out on the high prairie to the SE., destroying a great amount of fencing and timber and several small buildings. At Mound City, 8 miles SE. of Craig, the Methodist church was moved from its foundation, and several small buildings blown down. Three miles farther to the SE. the outbuildings on the farm of Mr. McIntyre, in Benton Township, were entirely destroyed.

Concluding the tornado's track at Dawson's Mills, or a few miles eastward, we find that its entire course from the northwestern portion of Riley County, Kansas, measured between 98 and 100 miles, which it traversed in two hours and fifty-five minutes, or at the rate of 30.5 miles per hour. In some portions of its track the rate was perhaps somewhat greater, several persons estimating 40 to 50 miles per hour as quite within the range of its progressive velocity. The tornado's general course was due NE., but subject to several variations, as I have carefully noted in this description, and as will be seen by reference to the accompanying topographical map of its track.

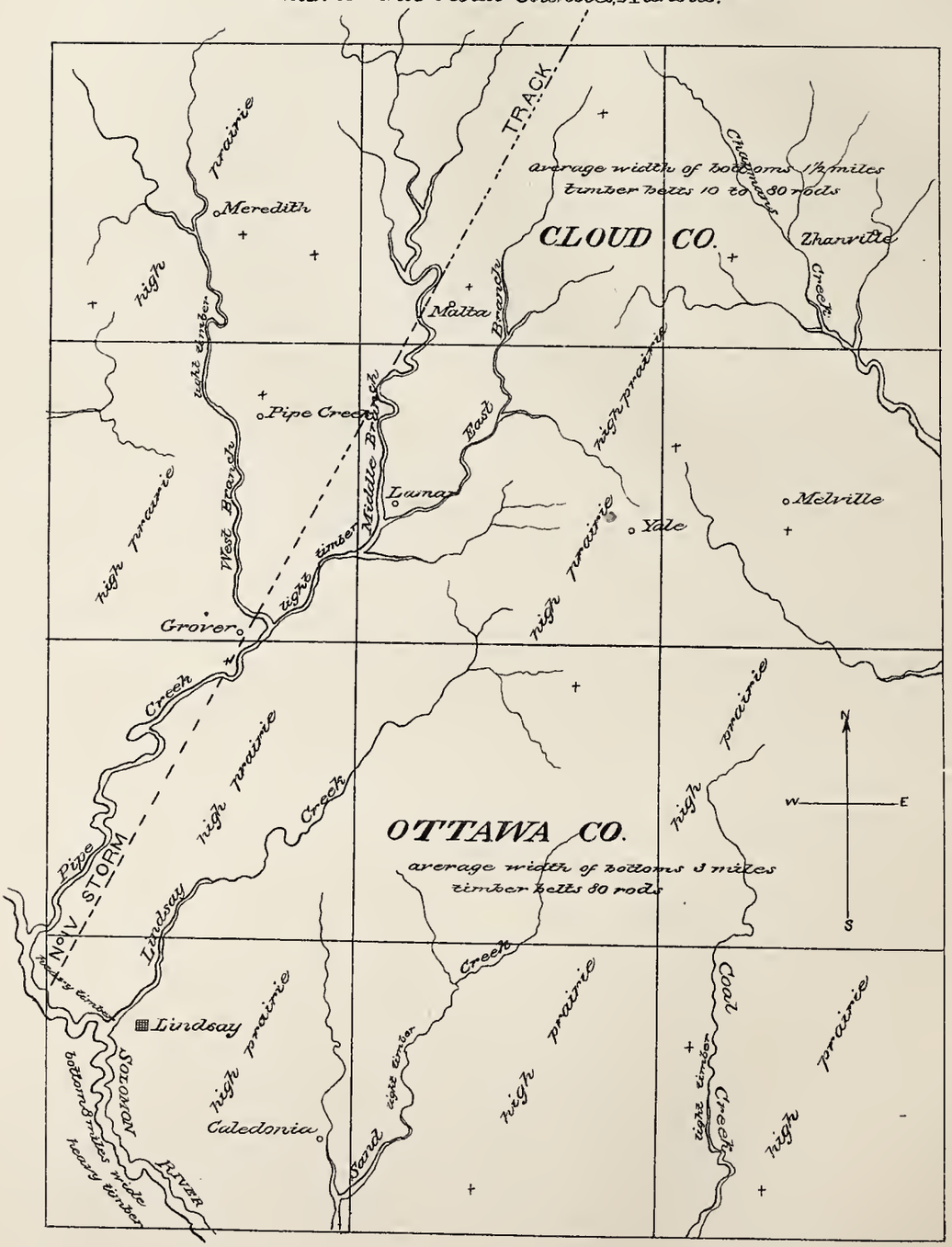
THE STOCKDALE TORNADO.

This tornado first made its appearance on the afternoon of May 30, over the farm of Mr. William Eddleblute, on Wild Cat Creek, 1 mile NW. of Wild Cat post-office. At about 6 p. m. Mr. Edddleblute, whose attention for some time had been drawn to the very curious manifestations of the clouds in the SW. and NW., saw in about the twinkling of an eye a narrow, rope-like cloud, of a lighter color than those surrounding it, shoot outward from the front of the SW. cloud and rapidly twist itself downward to the ground, which it reached about 60 rods SW. of his house, taking up clods of prairie grass and rails for a width of 30 feet. Outside of this diameter not the least destruction occurred and no strong wind was felt. After it passed it blew strong from the SW., changing finally to the NW., with a lower temperature. Previous to the formation of the funnel, rain and hail had fallen with a southerly wind, and some large hail-stones fell on the outer edges of the cloud while it was passing. From this point it raised from the ground and passed northeastward towards Stockdale, having remained upon the earth but for a distance of 40 rods. Mr. Eddleblute's property is situated along the bottom of the creek, bounded by high divides to the NE. and SW. The funnel formed over the latter and passed a considerable portion of the

valley before descending. To all appearances there was no influence exerted by the contour of the country, as the cloud rose before it left the valley and passed over several others before reaching Stockdale, where it first descended on the highest elevation in the surrounding region.

On the afternoon of May 30, at about 6.30 p. m., Mr. Jos. Condray, of Stockdale, saw a funnel-shaped cloud suddenly appear upon the high bluffs above his house to the S. and W. The building, a large stone structure 22 by 34 feet and two stories high, stood on the western banks of Mill Creek, at the very foot of the bluffs, which rise almost perpendicularly to the height of from 300 to 400 feet. Mr. Condray had just returned from Manhattan as the cloud made its appearance. It rose and fell, alternately contracting and expanding, and rotating in a direction contrary to the hands of a watch, which motion and direction Mr. Condray could easily distinguish. While over the summit of the bluffs the funnel seemed to halt for a moment or two, whirling very rapidly, and then, as if shot from the mouth of a cannon, it darted down the eastern declivity, tearing up the trees which lined its side, but in the creek bottom twisting off only the tops of the highest trees. In an instant thereafter it struck the SW. corner of the house, throwing in the S. end and lifting the roof directly upward, twisting it into atoms and distributing the *débris* over a width of about half a mile in a complete circle from right to left. The cloud had entirely passed the house in three or four seconds. Mr. Condray and family, and Mrs. Tatlock, with her infant babe, were in the house when the storm struck it. The latter were the only ones in the S. end, and when the wall fell in Mrs. Tatlock was crushed to death, but the babe in her arms was uninjured. Two members of the family received slight injuries from falling timbers. Mrs. Condray stated that as the cloud passed it enveloped the house in complete darkness, she experiencing a burning heat against her face which almost stopped respiration. The sensation lasted only a few moments, when she was relieved by a cool current of air. A pig-pen 20 feet E. of the house was torn to pieces and thrown to the E. Two hundred and fifty feet SE. of the house stood a small school-house, old and quite insecurely built, which was not even slightly injured. The entire width of the path of destruction was not over 40 paces, yet the storm was of sufficient power to uproot and break off trees 2 and 3 feet in diameter, and destroy the strongest buildings. During the day the weather had been sultry, continually threatening, and about half an hour before the storm there was a light fall of rain and hail, the latter very large. Mr. E. D. Somers, a merchant at Stockdale, and living about 80 rods W. of Mr. Condray's, watched the storm during its approach and passage, standing on the front porch of his store. First saw the funnel a distance of two or three miles SW. of the bluffs, moving to the NE. at a considerable height above the ground. When it reached the bluff it seemed to hang over it for a short time, and its whirling motion, which was against the sun, was distinctly apparent. It then rushed down the eastern declivity, drawing the trees inward toward its center from either side. The base of the funnel was sufficiently raised above the tree-tops for Mr. Somers to see the manner and direction in which their trunks were being bent, which was also verified by a personal inspection of the track afterwards. When it struck the house of Mr. Condray, Mr. Somers was positive that the roof was carried to a perpendicular height of nearly 200 feet. The whole action was plainly visible, and viewed with composure, as from the direction and dimensions of the cloud he was certain that it would not reach him. The roof was lifted, apparently as easy as if it had been a feather, shot upward in the very center of the cloud, and fairly ground to pieces, the *débris* whirling in circles about the upper portion of the cloud, and finally dropping to the ground one-fourth of a mile from the center of the storm's path. Mr. Somers stated very positively that the funnel divided when it struck the house, a smaller one shooting off from the main one as if sliced off by a sharp-edged tool. The small one came toward him a distance of about 100 yards, and then bore around to the NE., to be absorbed again by the main cloud about 60 rods from where they parted. Mr. Condray did not see the small one, which, of course, can be explained by the fact that the whole operation of dividing and reuniting was over before he had recovered from his terrible experience. When the cloud crossed the Big Blue River, one-fourth mile to the NE., Mr. Somers stated that a large amount of water was drawn upward and thrown upon the opposite bank, which was indicated by the manner in which the bank was washed, the grass beaten down, and the trees covered with mud. At Mr. Somers's store, only 80 rods W. of Mr. Condray's, hardly a breath of air stirred during the passage of the funnel, and it was very warm, but by the time the storm cloud had crossed the river there sprang up a cool breeze from the W., growing very cold during the night.

Exhibit A.
Map of the Track of the "Pipe Creek Tornado"
Ottawa and Cloud Counties, Kansas.



Hon. Nehemiah Green, ex-governor of Kansas, who lives one-fourth of a mile E. of Mr. Condray's, very kindly furnished me with important information concerning the tornado, which he watched with no little interest from the first. At 11 a. m. Mr. Green began at first to watch the clouds, which attracted his attention from their peculiar form and movements. He walked to the top of the high bluffs twice during the day to obtain a good view to the S. and W. From 11.30 a. m. to 4 p. m. black strips of clouds were moving from the SW. to the NE., accompanied occasionally by showers of rain. Between 5 and 6 p. m. send-like clouds of a light color were noticed shooting out from black clouds in the W. and SW., accompanied by fleecy clouds from other directions, all concentrating near Wild Cat Creek, about 7 miles to the SW., forming a central black spot or core, darker than the dark clouds surrounding it. In a short time a light, woolly-appearing cloud, of very narrow dimensions, commenced to descend from the center of this dark spot, and during its formation twisted about like a rope. While twisting it would dart downward at times in a spasmodic manner, then draw itself upward more slowly, each time descending lower and lower, until it struck the earth, when it again bounded upwards like a rubber ball. It now advanced, at a height of several hundred feet above the surface of the ground. The dark, heavy clouds from which the funnel depended, covering about 50° of the central portion of the sky, would move backwards and forwards on either side as the funnel lengthened and contracted. Mr. Green, who was then upon the bluffs, immediately descended to provide for the safety of his family. As the cloud reached the bluff, and while it hung thereon for a few seconds, the family waited in painful suspense for the result, which they were fully convinced was, from all appearances, a matter of life and death. It would certainly take Mr. Condray's house or his own, and perhaps both. Mr. Green shut his family within the house and awaited outside the result, which soon followed. As the funnel descended the bluff, and while passing Mr. Condray's, the wind blew so strong from the SW. that he could not stand upon his feet without grasping a tree. "When it reached Mr. Condray's the roof literally went up the spout" (to use Mr. Green's words) to a height of fully 250 feet, where it was broken to pieces and thrown outward to the ground on the edges of the storm. While the funnel was upon the bluff, hail of unusual size, but scattering, fell in his yard, mingled with a few large drops of rain.

Mr. William Denhof, of Manhattan, 12 miles SE. of Stockdale, stated that previous to the passage of the tornado at the latter place the wind at Manhattan was from the S. and threatening rain, but afterwards it changed to the NW. very strong and cool, lasting only a few moments, when it was succeeded by short gusts from all directions.

Mr. Henry Condray, of Randolph, 11 miles NW. of Stockdale, father of the gentleman whose property was destroyed, stated that during the passage of the tornado at the latter place a strong NW. wind prevailed at Randolph with light rain, the air being very cool. The wind just mentioned succeeded a tornado, which originated NW. of Randolph about two hours before, and afterwards passed northeastward to Irving. After leaving Mr. Condray's house the tornado crossed the Blue River near the mouth of Mill Creek, and passed northeastward into Pottawatomie County, between Carnahan and McIntire Creeks, and thence across the high divide between Blue River to the SW. and Rock Creek to the NE., where it finally disappeared. Over this portion of its track the funnel remained above the ground, doing no special damage, as the country was thinly settled. The entire length of the storm's track from Wild Cat Creek to the "divide" beyond Blue River was about 13 miles, and the course from SW. to NE. As to the progressive velocity of the storm I am obliged to depend entirely upon the statement of ex-Governor Green, who estimated it at between 25 and 30 miles per hour. The topography of the country over which the storm passed was especially rugged. According to the report of the State Board of Agriculture for 1878, it is known as the hilliest portion of Riley County, and comprises an area of 15 square miles, intersected by no less than seven different streams, besides Blue River. The average width of the bottoms are from ½ to 2 miles, and the bluffs range from NW. to SE.

THE PIPE CREEK TORNADO.

Pipe Creek derives its source from three small branches rising in the southern part of Cloud County, Kansas, all of which flow S. and empty into the main channel at intervals of about 2 miles. The latter runs from NE. to SW., and empties into the Solomon River near Minneapolis, about 10

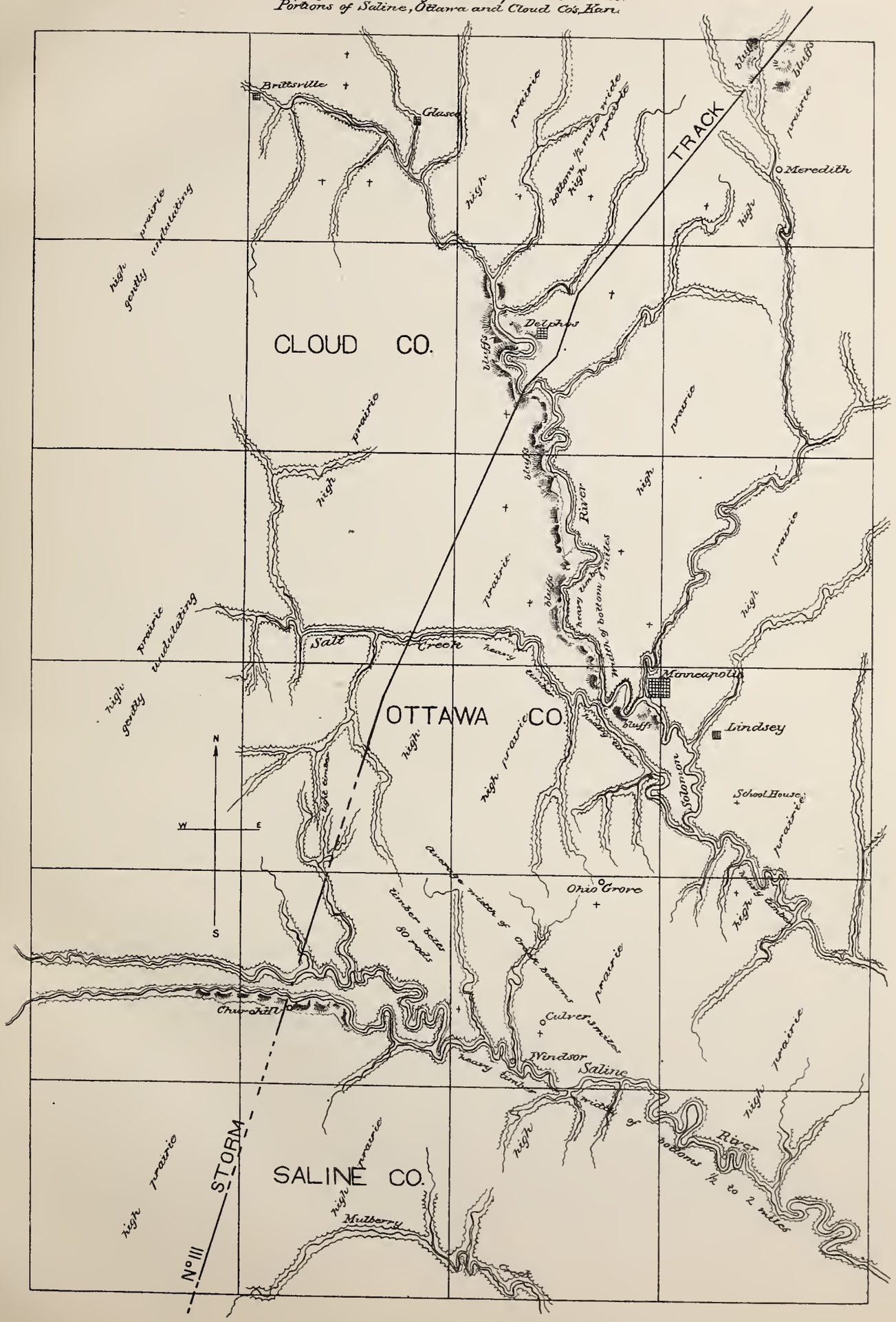
miles SW. of where the last branch strikes the main creek. The cloud made its first appearance on the afternoon of May 30 at about 4 p. m., a few miles SW. of the small town of Grover, situated on Pipe Creek near the month of the western branch, 10 miles ESE. of Delphos. It was above the ground and did not reach it in this vicinity, although the wind was strong enough from the S. during its passage to prostrate the entire N. side of the fence inclosing the cemetery. Several other fences were more or less damaged, and a few out-buildings were overturned. The tornado was preceded about twenty minutes with hail and rain, accompanied by a SE. wind. During the day until about 3 p. m. the weather had been sultry, cloudy, and at times threatening, with a brisk southerly wind. After leaving Grover the cloud still remained above the ground, passing to the NE. over the high prairie between the western and middle branches of the creek, crossing a section of country about 10 miles E. of Delphos. At this stage of the storm's advance Mr. James Courtney and others in Delphos saw this funnel, as well as the other, which came nearer the town. The former was a considerable distance ahead, moving rapidly, and surrounded by clouds which were rolling and tumbling in a fearful manner. Mr. Courtney stated that from all appearances it would have done as much damage as the tornado S. of Delphos, had there been as many houses within its course. As the storm crossed the line into Cloud County, 7 miles NE. of Grover, it dipped down and destroyed a small house which was occupied by a lone woman, who was carried out of the building a considerable distance and found insensible. Mr. B. Tracy, who lives about half way between this point and the track of the Delphos storm, stated that he saw both funnels distinctly as they passed by, high above the earth, and at least 10 miles apart. The one E. of him was a few miles ahead and somewhat smaller. Mr. Jos. Courtney, whose buildings were destroyed in the Delphos tornado, had his attention from the very first drawn to the one passing along Pipe Creek, which he had been watching with considerable interest and freedom from apprehension, because of its distance and height. While taking to himself a large share of satisfaction on account of his lucky escape, a sudden darkness fell upon him, and to his utter dismay he found himself within the jaws of a huge monster like the one which was moving at a safe distance to the E. He had heard heavy roaring on all sides of him, but had not for a moment ascribed its source to any other cause than the cloud passing away from him to the eastward. About 2 miles NE. of this point part of a "dug-out," consisting of the roof and one side, was carried away in a northeasterly direction. The width of the storm track was very narrow at all places of destruction, averaging about 60 feet.

Ten miles NE. of the Cloud County line, a stone school-house standing alone upon the prairie had the W. side of the roof and the N. gable end carried away and the *débris* scattered to the SE. and E. This was the last evidence of the storm's fury, and persons in the vicinity who could remember its passage stated that it did not again descend to the earth, but rapidly drew itself up into the clouds, entirely disappearing a few miles farther to the NE. The destruction caused by this storm was comparatively small, but it still possessed similar attributes of power to those of its companions, rendered notorious by their unparalled fierceness and length of path. Throughout its entire course of 16 miles it met little else but high, rolling prairie, and, of course, left but slight evidences of its path. Setting the time of its appearance over Grover at 4 p. m. and the time of its disappearance at about 4.30 p. m., as roughly estimated by people in the vicinity, we have a velocity of progression of the storm cloud of 32 miles per hour. It no doubt moved more rapidly than its companion, being most of the time above the earth, still, it is a very uncertain calculation upon which to base any comparisons of relative velocity. Of course it was next to impossible to obtain exact time, or even an approach to it, in this sparsely settled country. Very few of the residents had any clocks; those who had did not note the time, and those who had not depended upon the varying height of the sun.

THE DELPHOS TORNADO.

On the afternoon of May 30, at about 3 p. m., there was noticed to the S. of Churchill, in Pleasant Valley Township, Saline County, Kansas, the first manifestations of what proved to be a very severe tornado. From the house of Mr. F. S. Trew, near the S. line of Ottawa County, could be witnessed angry clouds gathering in the SW. and NW. and rapidly approaching each

Exhibit A.
Map of the Track of the "Delphos Tornado."
Portions of Saline, Ottawa and Cloud Cos, Kan.



other, from which soon after a funnel-shaped column of cloud was seen to descend. For about two weeks previous to the storm strong and continued southerly winds had prevailed with hardly a momentary change in the direction. No rain had fallen for several weeks, the ground was baked hard in the open fields, and vegetation suffered severely in consequence. During the 30th the weather had been extremely hot and oppressive, with a southerly wind, and the sky partially cloudy, but nothing of a threatening nature appeared along the horizon until about 2 p. m., when clouds came up rapidly in the W. and S., followed in fifteen or twenty minutes by a copious fall of rain and hail (wind SE.), the latter very large and scattering. This precipitation cooled the heated air very perceptibly, and by the time it had ceased the funnel before mentioned was seen dangling from the SW. cloud, which was in frightful commotion several miles to the W. Other eye-witnesses saw two or three smaller funnels, like whip-cords, darting downward in close proximity to the larger one, but finally to all appearance absorbed by it, leaving nothing but the main funnel cloud. The tornado advanced a distance of about 8 miles, at a considerable height above the ground, until it reached the timber along Saline River, in section 18, Culver Township No. 12, Ottawa County, range 5 W., where it reached only the tops of the trees, destroying the foliage and limbs, but did not descend to the river bottom. Mr. Trew's house was not injured, as the funnel was at too great a height in the air, and for a distance of 4 miles to the NE. several other buildings were left untouched, although situated alternately upon high and low ground. The funnel had now nearly reached the high divide between Saline River and Salt Creek, which trends from WNW. to ESE., and averages about 200 feet above the general level. In passing up the southern slope the house of Mr. J. K. Disney was first unroofed and then swept clean from its foundation, the *débris* being carried along the track to the summit of the divide, where it was thrown about in every direction during a momentary halt in the progressive movement of the cloud. It was reported by a neighbor of Mr. Disney's that during the storm which preceded the tornado three hailstones were picked up which weighed together 6½ pounds, one of which, very jagged and irregular, turned the scales within a fraction of 3 pounds. As the tornado descended the northern slope, it next encountered the house of Mr. Henry Kinsey, on the W. side of the storm's center, injuring it but slightly, but entirely demolishing his granary, not 60 feet to the E., scattering the grain and timber to the SE. On the farm of Mr. Peter Boek, in the adjoining township of Fountain, about 4 miles to the W. of the storm's center, and during the prevalence of the severe hailstorm that preceded the tornado, masses of ice fell as large as a man's head, breaking in pieces as they struck the earth. One measured 13 inches in circumference, another 15, and a hole made by one that fell near the place of Mr. J. H. Kams measured 7 inches across one way and 8 the other. This immense fragment of aerial ice broke into small pieces, so that its exact size could not be determined. Strange as it may seem, no appreciable harm was done to the standing crops, excepting the harvesting of a considerable quantity of peaches. The storm cloud, now at a point 8 miles W. of Minneapolis, entered Salt Creek Valley, pursuing nearly a direct NE. course, and after rising from the ground beyond Mr. Kinsey's it simply overturned the house of Mr. T. C. Deardoff, 1½ miles distant, injuring some of the family. I will now introduce a short report of the storm, as kindly furnished me by Mr. C. C. Olney, land agent at Minneapolis, a very intelligent gentleman, and one who took considerable interest in matters connected with the storm. He traveled over, quite carefully, that portion of the track between Minneapolis and Delphos:

My observations of the tornado passing through a part of Ottawa County, Kansas, on May 30, 1879, were as follows: About 2 p. m. a light shower with some hail, coming from the SE., lasted about ten minutes. Afterwards it was cloudy, wind from several different directions, but light, continuing for an hour, followed by a second shower very much like the first. Some few hailstones were picked up 2½ inches in diameter. I was standing on an eminence at the outskirts of the town, overlooking more than half the county. The rain cloud which preceded the tornado, after passing, seemed to meet a second cloud coming from the NW. The clouds were quite black and rolling about in a fearful manner. The first appearance of anything in the shape of a funnel was a whirling cloud about the diameter of the full moon, which rapidly stretched downward towards the earth, but in a few minutes was broken up and disappeared at a point of about 12 miles WSW. of the town. About ten minutes thereafter, a portion of cloud a trifle S. of W., began to descend from the main body, shaped like a tea-cup, and apparently about four times the diameter of the full moon. This passed in a northerly direction, growing larger and getting lower, until, at a point directly NW. of here between 5 and 6 miles, it struck the earth. From this point to where it left our county was about 10 miles, the storm passing very nearly in a right line, going E. 2 miles and N. 10. The circular motion of the cloud was reverse to that of the hands of a watch, and the diameter of the cone at the earth about three-quarters of a mile, and

its height apparently between three and four diameters of its base. The rotary motion of the outside of the cone, near the earth, was such as to make a complete revolution in from half to three-fourths of a minute. Its direct motion was about 20 miles per hour. It crossed the Solomon River, cutting a swath through the timber from half to three-fourths of a mile wide, stripping all of the trees of foliage and limbs. Large trees from 2 to 3 feet in diameter were twisted off; oak trees from 6 to 12 inches through were twisted around till their trunks for several feet looked like ropes of wood. Very little water fell during the storm, only enough to stick fast the dirt taken up by the wind. I examined the banks of the river closely for any sign of the water having been taken out of it, but could not find any. The grass was dirtied by dust and the sprinkling of rain, but not plastered down as by any large amount of water, nor was there any evidence of a large amount of water having fallen for 5 miles NE. of the point where the storm cloud left the river, that being as far as I followed the storm track.

Mr. William Goddard, editor and proprietor of the Minneapolis Independent, kindly furnished me with the following description of the storm:

About 3.30 p. m. of Friday, the 30th of May, a thin film of clouds gathered like a dark sheet just above the horizon, in a southwesterly direction from this city, spreading itself and making very little progress in its struggle to mount higher and higher into the heavens against a strong easterly wind, which had kept up a steady and interminable sweep athwart the heavens, carrying dense masses of clouds, which occasionally spattered the earth with rain and hail, laying the dust and cooling the atmosphere. The storm cloud in the SW. seemed to gather in density, and occasional sharp strokes of thunder rolled ominously through the air, without raising any suspicion of the terrible danger that lay slumbering in those elements and the sad scenes that would follow the wake of that seething mass of clouds of rain and hail, which was so soon to lay its destructive hand on the unsuspicious watchers of its progress. For some time the cloud seemed to be mounting the heavens and coming directly over the city, with no apparent danger in its folds other than deluging the earth with rain and hail. At this juncture the storm had gained a large audience of citizens, and on the southern edge was noticed an unusual commotion in the clouds. They seemed to stir around and intermingle in a state of ebullition, as if one of the opposing currents of air, which met each other obliquely, was about to gain a passage into and beyond the mass of storm clouds, with their strong backing from the SW. In and among, round and round, went the clouds, until plainly could be seen the rotary structure, and all doubt was dispelled as to the nature of the storm. A tornado was forming, and to all appearances was making straight for the city. Its distance from the town seemed to be about 7 or 8 miles, when, in fact, it was double that distance. For a time it moved on, coming straight across the divide, between the Saline and Solomon Rivers. The funnel-shaped cloud looked like an elephant's trunk, as it depended from a dark and irregular mass of clouds above. Its body was very dark and dense, and appeared to be about 20 feet in diameter at a distance of 10 miles. The weather previous to the storm had been oppressively hot and very enervating; everything was drying up in the fields and gardens under the influence of a sultry southerly wind.

After the tornado crossed Salt Creek it descended near Mr. Rathgiber's, in the SE. corner of the NW. quarter of section 21, township 10 N., range 4 W., Ottawa County. House stood E. of the storm's center half a mile. The roof was blown off, carried 50 rods to the NE., and torn to pieces. His granary, 50 feet S. of the house, was likewise unroofed. For a distance of 2½ miles the storm cloud passed over the open prairie, where but little or no material existed that might leave evidence of its course, until the house of Mrs. Sophronia Clark was reached, located in the center of the storm's path and in the NE. corner of the NE. quarter of section 9, three-fourths of a mile SW. of the Solomon River. The building, 16 by 28 feet, and one and a half stories high, was lifted bodily from its foundation and carried a distance of 90 feet to the NE., where it fell in a shapeless mass of ruins, which were scattered towards every point of the compass. The granary, only a short distance W. of the storm's center, was simply unroofed. The tornado had now reached the wide bottoms of Solomon River, stretching out a distance of 3½ miles to the E. and 1½ miles to the W., where on either side they gradually ascended 250 feet to the high, rolling prairie beyond. Mr. James Potter's stone house, 120 rods N. of Mrs. Clark's and 40 rods W. of the storm's center, was unroofed, the walls falling in upon the floor. The roof was torn in pieces and portions carried to the W. and SW. The family escaped with slight injuries by going to the basement.

The place of Mr. Samuel McBride, 4 miles due S. of Delphos and 150 yards S. of the river, which at this point bends to the W., but whose general course is from NW. to SE., was next reached. The house, standing about 60 feet N. of the storm's center, size 20 by 30 feet, and one and a half stories high, was moved from its foundation first 10 feet to the N. and then 12 feet to the NW., when it was torn in pieces and the *débris* scattered from 60 to 80 yards to the NW., W., and SW. Mr. McBride, who was in the cellar at the time, escaped injury; but Mr. Frank Zeck, a hired man who was within the house, was carried out (when it went to pieces), 100 yards to the W., dislocating his hip and arm. Mrs. McBride's father was badly crushed about the head and shoulders by falling timbers, dying from his injuries shortly after the storm. After the cloud had

passed, an attempt was made to draw water from the well, but it was found to be impossible, although there was a depth of several feet before the storm. The well-curb was blown away and it was thought that the violent suction of the whirling clouds had drawn the well dry.

Another freak of the storm was manifested in the destruction of a strong iron-bound trunk, containing some $4,000 in greenbacks. The money was tied up in $500 packages, containing smaller packages of $100 each, which crossed each other at right angles, and the whole was firmly bound together by strong cords; then all the large packages were tightly bound together and placed in a bag, which was securely tied, deposited in the trunk, and locked therein. After the storm all but $500 was picked up in separate bills, scattered here and there throughout the rubbish. This story was confirmed by Mr. Olney, of Minneapolis, who, previous to the storm, had visited Mr. McBride to receive purchase-money for land, and noticed the trunk and the peculiar manner in which the money was secured. (Diagram No. 1.)

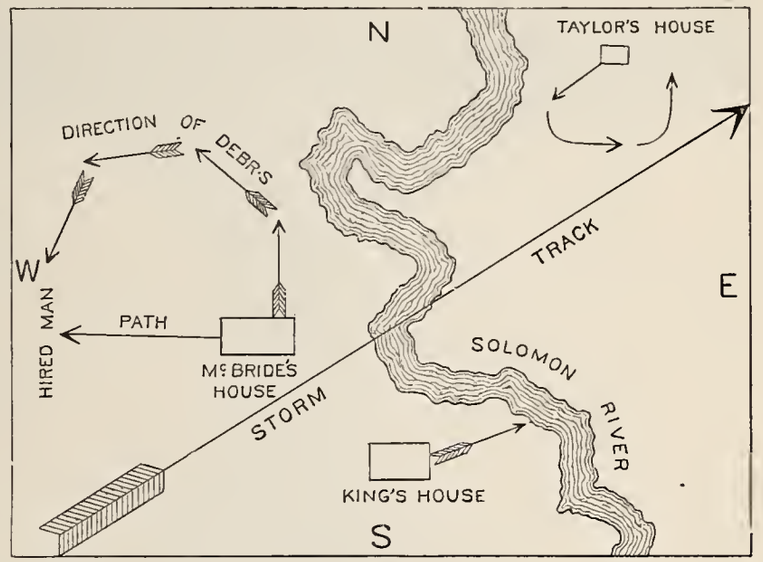


Diagram No. 1.

The house of Mr. J. W. King, SE. of Mr. McBride's, and on the same side of the river, but S. of the storm's center, was lifted bodily from its foundation, carried 300 feet to the ENE., and deposited within 50 feet of the edge of the river. It was not torn to pieces but badly racked. In crossing the river, which runs from NW. to SE., but very irregularly, the storm cloud spread out to a width of $1\frac{3}{4}$ miles. Here in the timber, as usual, it manifested the most terrific power, breaking off cottonwood trees 3 feet in diameter close to the ground and twisting others of smaller diameter into ropes. Many of the trees were entirely stripped of their limbs, leaving bare trunks for a height of from 50 to 60 feet. The timber had been so dense and high that from a point one mile E. of the river the high hills to the westward could not be seen, while now the low lands along the river bottom, and even the very edges of the opposite banks, were plainly visible. Every little bend in the river was equally shorn of its covering and brought into view, and the bed of the stream was choked up with the shattered trunks of trees, broken limbs, large logs, and timber from the adjoining houses, over and through which the water bubbled and boiled in eddying whirls. It was reported by some and denied by others that the water was sucked out of the river as the funnel passed over. The small log house of Mr. James McBride was the first building demolished on the eastern side of the river; it was unoccupied at the time. On the S. side of the track, only a short distance to the NE., the house of Harry Gable was unroofed and the *débris* carried to the E. His horse was killed by flying timbers, and a wagon torn into pieces.

On the N. side of the track, and three-fourths of a mile NE. of Mr. McBride's, stood the new story-and-a-half house of Mr. C. S. Taylor, which was lifted from its foundation and carried 25 rods to the SW., then torn to pieces and the *débris* scattered to the E. and N. A large portion was carried into the peach orchard, directly S. of the house about 15 rods. The family escaped by going to the cellar, with the exception of Mr. Taylor, who ran out of the house to the W. and grasped tightly about a small sapling, around which he was whipped, receiving severe injuries. One mile E. of the river and 3 miles SE. of Delphos stood the house of Mr. J. D. McLaren, upon a slight rise of ground, surrounded by an osage hedge and a grove of young cottonwoods. As the funnel sped onward to the NE. it left the house half a mile to the eastward unharmed, although the wind blew exceedingly strong from the SW., and the building was enveloped in darkness and constantly peppered with flying *débris*. Mr. McLaren was so situated that the storm could be watched almost from its inception, and from him I obtained a very interesting account of its formation and progress. On Friday morning the weather was very pleasant, but warm, with the wind

from the SE., from which direction it had blown for several days. The ground was very dry, and no rain had fallen for a number of weeks. About 2 p. m. threatening clouds appeared very suddenly in the W., attended in a few minutes by light rain, wind still in the SE. It stopped in about five minutes and then commenced again (wind the same) accompanied by hail, which was thick and small at first but rapidly grew less in quantity and larger in size, some stones measuring 3½ inches in diameter, and one was found weighing one-fourth of a pound. This last precipitation continued for about thirty minutes, after which a cloud in the shape of a waterspout was seen forming in the SW., and moving rapidly forward to the NE. The cloud from which the funnel depended, seen at the distance of 8 miles, appeared to be in terrible commotion; in fact, while the hail was falling, a sort of tumbling in the clouds was noticed as they came up from the NW. and SW., and about where they appeared to meet was the point from which the funnel was seen to descend. There was but one funnel at first, which was soon accompanied by several smaller ones, dangling down from the overhanging clouds like

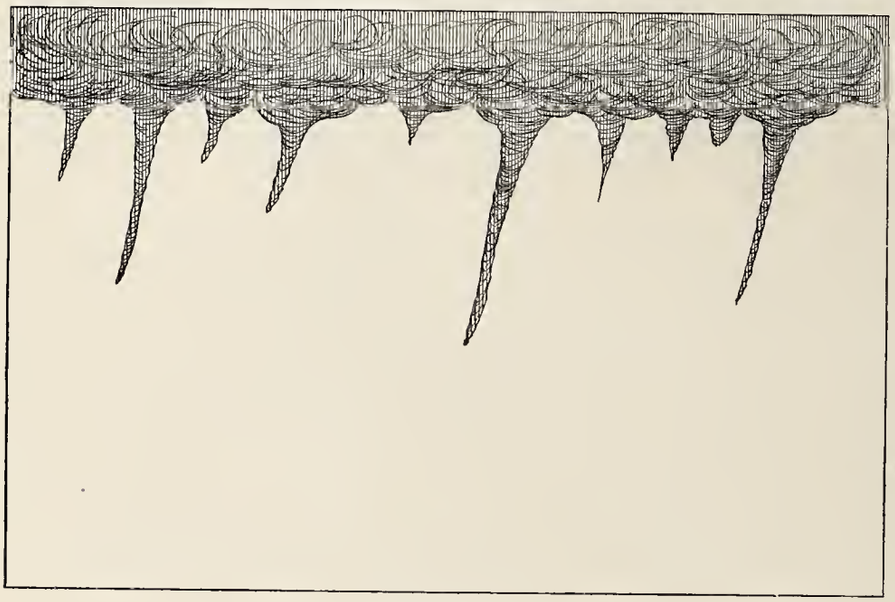


Diagram No. 2.

iplas hes, and for some ten minutes they were appearing and disappearing like fairies at play. (Diagram No. 2.) Finally, one of them seemed to expand and extend downward more steadily than the others, resulting at length in what appeared to be their complete absorption. This funnel-shaped cloud now moved onward, growing in power and size, whirling rapidly from right to left, rising and descending, and swaying from side to side. (Diagram No. 3.) When within a distance of 3 or 4 miles, its terrible roar

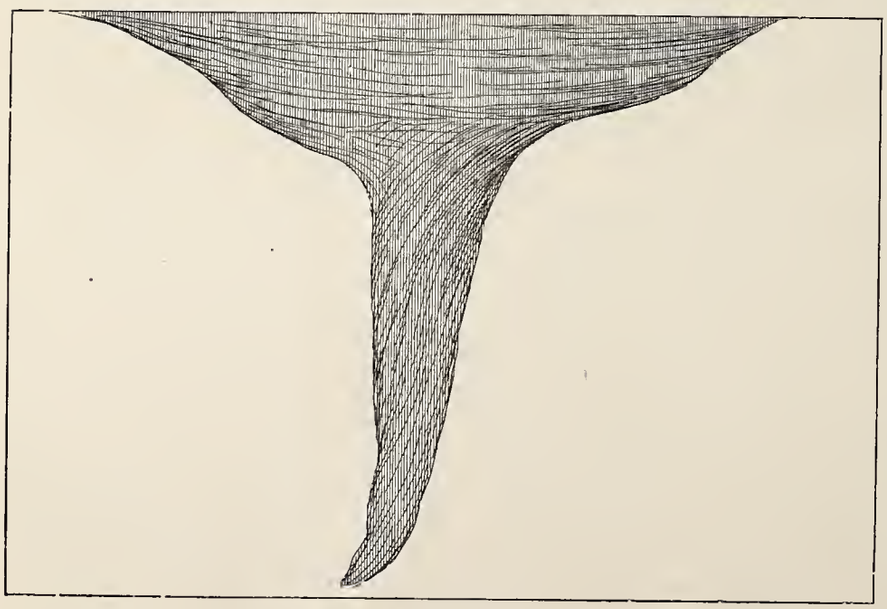


Diagram No. 3.

could be heard striking terror into the hearts of the bravest. About this time Mr. McLaren judged that the cloud from which the funnel depended would cover about 45° of the heavens, and that the funnel itself would reach a height of about 500 feet. (Diagram No. 4.) As the storm cloud crossed the river, a cone-shaped mass came up from the earth to meet it, carrying mud, *débris*, and a large volume of water. (Diagram No. 5.) The cloud passed Mr. McLaren's house at very near to 4 p. m., and he is positive that it could not have been five minutes either way from that hour. The pro-

gressive velocity at the time of passing was considered to be about 30 miles per hour, although at Delphos, 3½ miles distant, it had slackened down to near 20 miles. A few minutes previous to and during the passage of the funnel, the air was very oppressive, but ten minutes after, the wind was so cold from the NW. that it became necessary to wear an overcoat when outside.* (Diagram No. 6.)

In the accompanying diagram I have arranged lines showing the comparative force of the winds within the storm's path at different distances E. and W. of the center of disturbance. The data was secured from parties living on opposite sides of the storm track in the neighborhood of Mr. McLaren's, and prepared with his assistance. (Diagram No. 7.) The following description of the tornado is from the pen of a young son of Mr. McLaren, which presents some interesting facts in a pleasant but graphic manner:

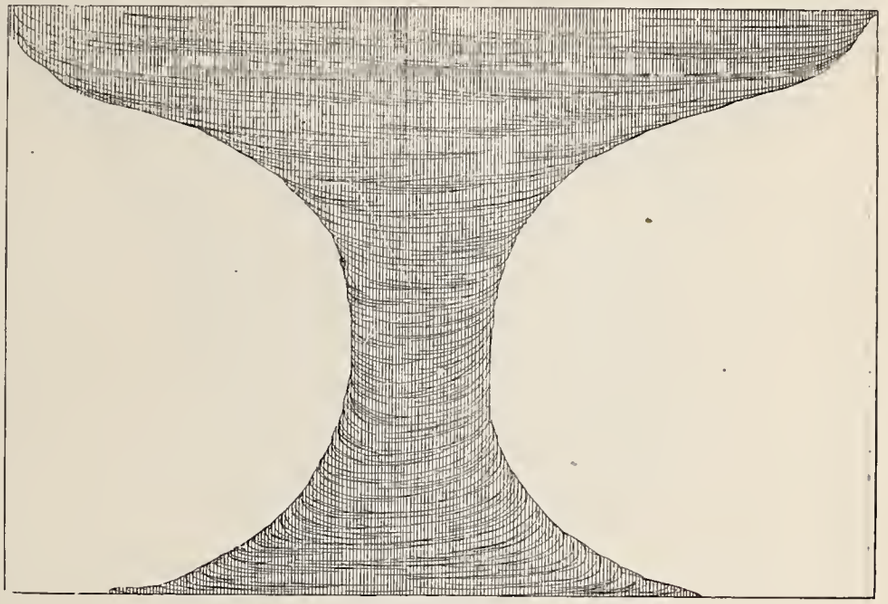


Diagram No. 4.

It rains so gently this afternoon that the weather is really enjoyable. Plants grow and flowers bloom as they never do when it is dry. The Solomon Valley seems almost a second garden of Eden. A short time before the clock strikes three some hail begins to fall, which rapidly increase in size. We gather some of the largest, and find that it takes six of them to weigh a pound. But notice that hail cloud south of the river! What wonderful contortions, evolutions, and twistings! The hail that is falling from it is plainly visible from here, although it is 4 miles to the SW. A few strips of cloud, like whip-lashes, hang from it. The cloud now revolves rapidly from right to left. We gaze at the magnificent scene with awe and wonder. The center becomes lower and lower until it resembles a funnnel. The truth now bursts upon us. *It is a tornado!* We hear its awful roar, like an earthquake or distant thunder. The funnel rapidly descends till it reaches the earth. It moves rapidly northward. It rises, a dark cone ascends from the ground to meet it, and it descends. It strikes the river. All the water is drawn from the channel, perceptibly widening the cone. From the first the tornado has had the appearance of a waterspout at sea. We think it is coming near us. We can now see its fury. It is not far away.

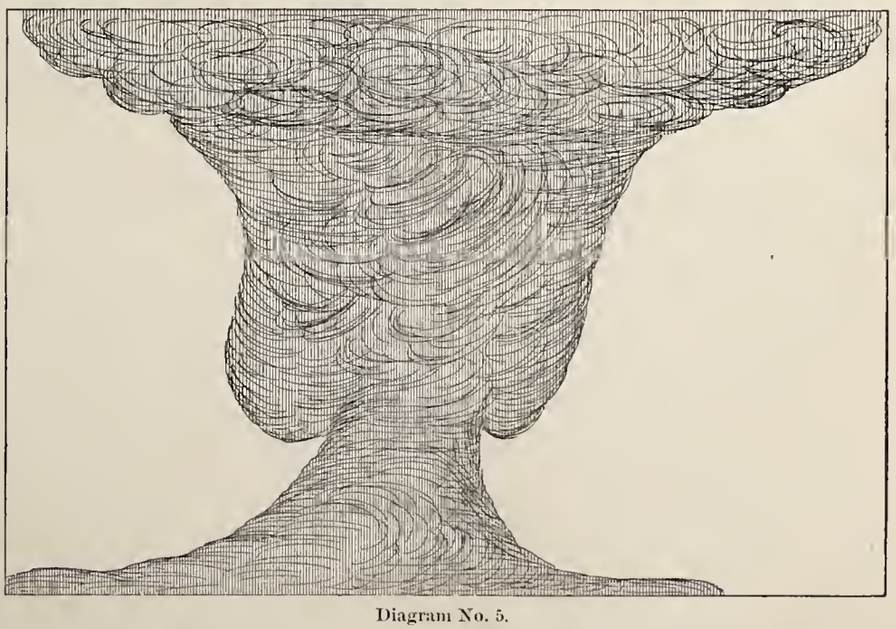


Diagram No. 5.

Shall we leave the house? No; for we are not certain on which side it will pass We are apparently as safe here as elsewhere. We can only trust in Providence. The windows are nailed fast. Three of us lean against the door which is nearest the storm. The rest go into the cellar. It is about 4 p. m. A moment of breathless suspense and the storm strikes us. The timbers creak, the sides of the house sway in and out. Surely they cannot outlast it. We hear no well-defined roar now, for on the outside boards and other *débris* are fiercely clashing. All is dark within. In about fifteen minutes the storm is over. We leave the house. The center of the storm has passed to the W. of us, and we can see its dark form moving away in a NE. direction.

Returning again to the track of the storm, the next house visited, after passing Mr. McLaren's, was that of Mr. Henry Voshman, standing 20 rods E. of the storm's center. It was entirely demolished, as well as the stable NE. of it, hardly leaving a trace of the foundation. Almost the entire wreck was carried in toward the center of the track to the NW., and then scattered in every direction. A large two-horse sulky plow, weighing about 700 pounds, was carried a distance of 35 rods, breaking off one of the iron wheels attached to an iron axle $1\frac{3}{4}$ inches in diameter. Two stoves were found broken into small pieces, not any of them larger than 6 or 8 inches square. Wagon hubs without a single spoke in them, wagon tires curled into fantastic shapes, pieces of clothing and bedding wound about sticks and timbers or scattered over the prairie, were the only signs of the once thrifty home. The tornado at this point turned almost due N., bearing but little E. throughout the remainder of its course, which lay along the wide valley of the Solomon to the E. of the river. Where this change was made in its course there was present no peculiar feature in the topography. Mr. Voshman's house stood out upon the level bottom of the prairie nearly 5 miles from the surrounding bluffs, which rise gradually to a height of 250 feet, exemplifying, as many other instances have, that the course of the funnel was determined almost altogether by some force above the earth, in all probability the opposing currents which formed it. One-quarter of a mile N. of Mr. Voshman's stood the house of his father-in-law, Mr. Gehart Krone, about 80 feet E. of the storm's center. Mr. Krone saw the cloud, which to him looked like a waterspout at sea, coming from the SSW, at a distance of 2 miles. It was a dark, heavy, black mass of smoke and flying *débris*, with well defined outlines, and to all appearances separated from all surrounding clouds. He could easily distinguish that the tornado's rotary velocity was much greater than its progressive, and that the direction of the motion was against the sun. The funnel was also rising and falling continually, contracting in size with the former motion, but expanding with the latter. He waited until the cloud reached within half a mile of the house, and then, calling together his family, with several friends and strangers, numbering in all twenty (the latter having sought shelter from the

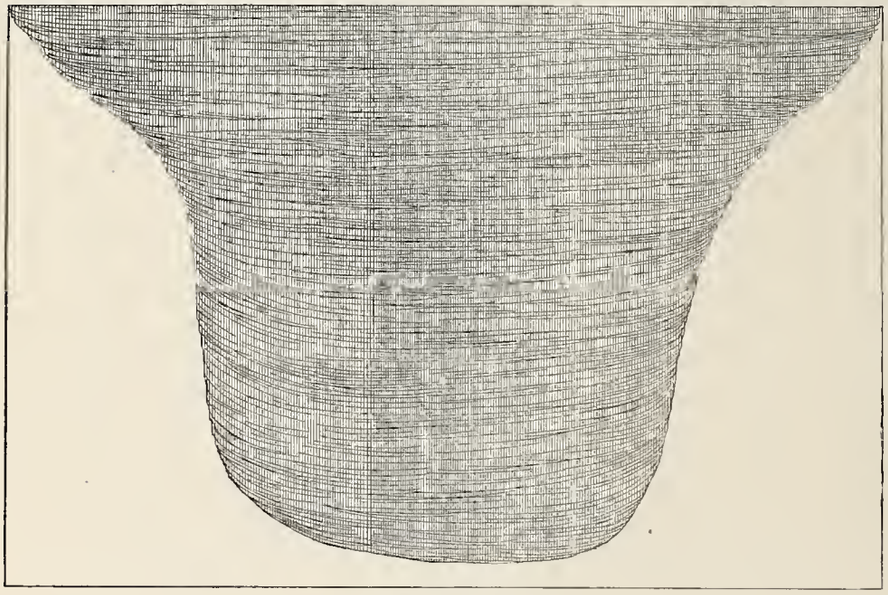


Diagram No. 6.

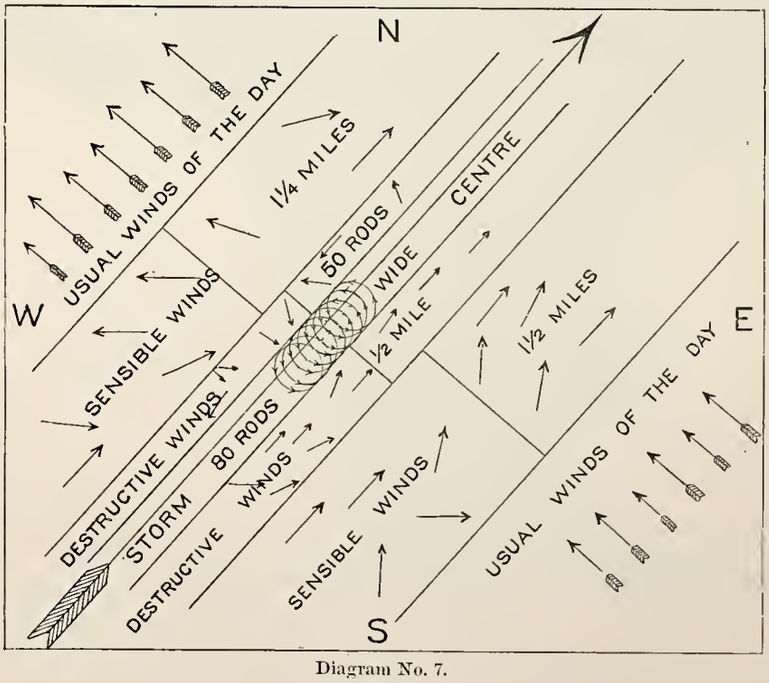


Diagram No. 7.

impending danger), he bade them start out from the house, which was sure to be destroyed, and find safety elsewhere.

Mr. Krone had hardly gone 30 rods to the NE. when the house was struck on the E. side and carried directly into the storm's center to the W. Most of the *débris* was scattered to the W. and NW., but portions were found to the SW., SE., and E. Mr. Krone was thrown to the ground, afterwards lifted several times and rolled about, his head and body being badly bruised by the flying *débris*. While he was bumped about he felt a suffocating heat, which he likened very much to that experienced while working over an iron smelting furnace. This sensation was shortly followed by a comparative calm in the atmosphere, lasting a few moments, when a cold wind came from the NW. that made his teeth chatter. That night frost occurred along the valley, which was seen by several persons early the following morning. Mrs. Voshman, Mr. Krone's daughter, who stood near her father after they left the house, was carried to the NW. 200 yards, lodged against a barbed-wire fence, and instantly killed; her clothing was entirely stripped from her body, which was found covered with black mud, and her hair matted with it. The posts along the entire fence, a distance of 25 rods, were covered, on the S. side only, with mud, straw, chaff, and bits of rags to a depth of nearly three inches, and near the bottom of the posts it was 1 foot thick. It was plastered on as if thrown with the greatest velocity, requiring a sharp instrument and considerable physical exertion to remove it. Five of the posts were pulled out of the ground, into which they had been sunk to a depth of 28 inches. The wire was entirely stripped off and wound up into a ball, which was about the result with every wire fence along the storm's path. The oldest son of Mr. Krone was carried 30 rods to the E. into a wheat field, his clothing torn into shreds, and his body covered with black mud. Mrs. Anna Vosh, another daughter of Mr. Krone, had a piece of board driven nearly through the fleshy portion of her thigh, cutting a gash about 7 inches wide; the board was pulled out during the storm, probably by the violence of the wind. The ghastly wound, upon being examined by the attending physician, was found to contain pieces of nails, straw, mud, and splinters of wood. The other members of the family were carried to the N. and NW., short distances, all receiving more or less injury. The women suffered the most, as in every instance they were entirely divested of their garments, and left perfectly at the mercy of the flying *débris* that filled the air. The hair of all the persons was so matted with mud that their heads had to be shaved in order to clean them, or, as one gentleman remarked who witnessed the scene, "it seemed as if the mud belonged there naturally, and that the hair was but a mere usurper." Their eyes and ears were also filled with mud, so that they could neither see nor hear. All of the wounds received were torn and jagged, and found mostly upon the back of the body and running upward. Two men, by the names of T. W. Carter and Jacob Garber, who stopped to seek shelter, were seriously injured. The latter, who crawled into the granary, standing NE. of the house, received injuries from which he died, being rolled and blown about the ground until his clothing was filled with mud and his body badly mangled. The former took refuge in a straw stack N. of the house, which was turned over upon him by the wind, and then scattered in every direction, leaving him to the complete mercy of the storm, which lifted him, how high he did not know, but while above the ground he came in contact with the tail or mane of a horse, which he grasped, but was finally separated from, coming down to the earth with hat in one hand and hair in the other. This statement was made to me by a reliable gentleman who received the same from the lips of the unfortunate æronant. Mr. Krone, while upon the ground, saw what he positively asserted was a light two-horse wagon with one horse attached, go up together, but could not say how high. Upon further examination, this proved to be a portion of the property belonging to Mr. Kine, of Beloit, who had driven up before the storm and hitched at the granary. One of the horses had jerked away from the wagon in some manner, and the other, with the wagon, was left standing until taken up, as before described. Hardly a vestige of the wagon or harness could be found, and one of the animals was killed.

Mr. Krone's granary stood three rods ENE. of the house, and was filled with several hundred bushels of corn. Only the roof and a portion of the W. end with some of the grain were carried away. The large barn, 40 feet square with 16-foot posts, standing 20 feet N. of the granary, and 65 feet NE. of the house, was completely demolished, and every timber carried away from the

foundation. The *débris* was scattered to the W. and NW. Six horses were killed, two outright and the others so seriously injured by flying *débris* driven against and into their bodies that they had to be shot. One was badly mangled about the body, and had nearly all its bones broken, having fallen from a considerable height, making a large depression in the tough sod of the prairie. Eighteen fat hogs, weighing from 300 to 500 pounds each, were killed outright, and six others died afterwards from their injuries. One weighing 300 pounds had a scantling 7 feet long and 6 inches square driven lengthwise through its body; another had a fence board driven through it in the same manner, and still another had a sharp-pointed post driven through the body from side to side; one was carried 300 yards to the NW. on the prairie. Two new lumber wagons were carried, one 35 and the other 40 rods to the NW., and broken into pieces; one of the wheels, nearly whole, was found a distance of one mile NW. of the barn; the other wheels were broken from the axles, divested of their spokes, and the large heavy iron tires were bent into every shape. A log from the barn, 12 feet long and 10 inches in diameter, was carried 320 yards to the NNW. The front iron axle of a top buggy (1½ inches in diameter) was found bent double, the two ends crossing each other and both wheels were torn off even to the hubs. The hind axle, with portions of the wheels attached, was not bent as much, but carried to the NW. nearly one-quarter of a mile. A sill from the house, 8 by 10 inches and 16 feet long, was carried 12 rods to the NW. A cat was found half a mile NW. of the house (in which she was seen just before the storm) with every bone broken, and crushed as flat as if passed through a cider press. Chickens were stripped of their feathers and carried long distances, one being found 3 miles to the NE. upon the prairie. The iron mole-board of a heavy wooden-beam plow was found driven into the ground so firmly that it had to be dug out; the plow was no doubt first lifted and then thrown end foremost into the earth, and afterwards broken off. Osage hedges along the track N. of the house were filled with *débris* as follows: Those running N. and S. on both sides, the E. side with the forward part of the whirl, and the W. side with the backward movement to the S. and SE.; those running E. and W., were filled on the E. side of the storm's center from the S. and on the W. side from the N. The well bucket and rope were pulled out of the well and carried half a mile to the NW., but the water was not disturbed. South of the house a few rods, the funnel cloud swept over a wheatfield of about 6 acres, taking off the heads of wheat as cleanly as if done by hand. Heavy cast-iron wheels, broken from a large harvester, and weighing about 200 pounds each, were carried half a mile. (Diagram No. 8.) Mr. McLaren, who came over to Mr. Krone's about ten minutes after the storm passed, stated that the scene presented baffled description. It was yet very dark. A cold wind was blowing from the NW. necessitating an overcoat. The ground was soaked with water and the surface covered with thick heavy black mud. As the terrible scene of desolation was approached the cries of the wounded people and the moans of the tortured animals were plainly heard, which, mingled with the distant roar of the storm, filled one with an indescribable fear and dread of the awful monster that was still in sight, and was a fearful reminder of its terrific force. Upon arriving at the ruins of the once happy home a dreadful sight was presented. Human beings could not be distinguished from animals as all alike were covered with mud and mingled with an interminable mass of *débris* in the most sickening manner. Women and children stripped of their clothing were found lying by the side of horses and hogs. Now an arm or a leg would be raised up from the filthy mass surrounding them, attended with a piercing shriek for help,

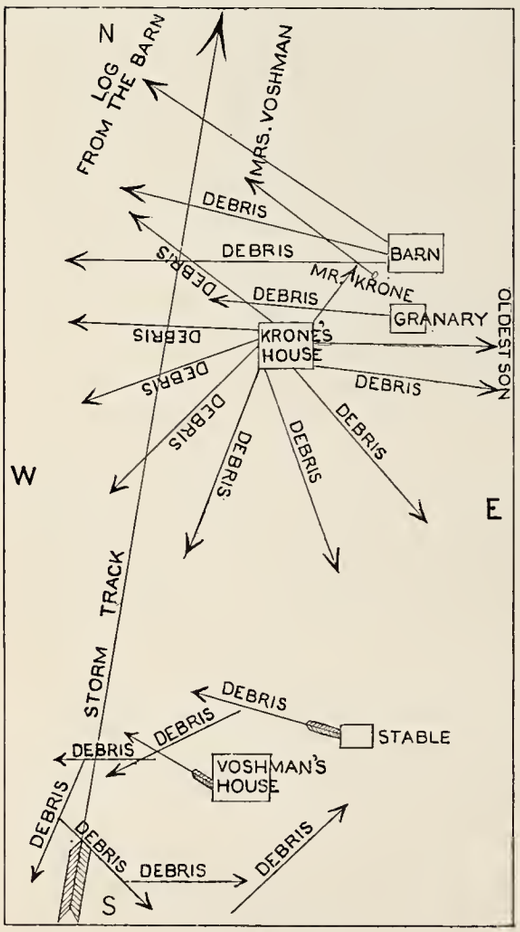


Diagram No. 8.

and upon examination ugly gaping wounds were found filled with mud, straw, and bits of wood. This was the worst destruction in the whole course of the storm and was confined to a path about 80 rods wide.

The next place visited was the house of Mrs. A. Eames, half a mile to the N., and standing 160 feet W. of the storm's center. The house, stables, and sheds were razed to the ground, and the *débris* carried to the W. and SW. One mile N. of Mrs. Eames's the houses of Messrs. R. A. King, Silas McCalmnt, and Robert Whitley, were reached by the storm about the same time, as they all stood on the same E. and W. section line and within short distances of each other. The funnel now bore more to the E. in its course along the valley, and passed between the houses of Messrs. McCalmut and Whitley, the center being 120 rods W. of the latter and 18 rods E. of the former. Mr. King's house, which stood one-fourth of a mile W. of the storm's center, was a new building, 18 by 20 feet, and one and a half stories high. It was completely demolished and the *débris* carried to WSW. and SE. The family escaped by going to the cellar. The residence of Mr. McCalmut was thrown in the same direction, but, if possible, more badly wrecked, the timbers being fairly ground into splinters. Mr. McCalmut was killed by flying *débris* while trying to find a place of safety. The house of Mr. Whitley was destroyed and the *débris* carried to the N. and W. For a distance of $1\frac{1}{4}$ miles the tornado now passed over the open prairie, with nothing particularly to mark its course except now and then a small cornfield, which, if ever damaged, had entirely recovered its natural condition at the date of my visit.

The large frame house of Rev. Joy Bishop was next reached, standing 50 feet W. of the storm's center. The entire structure was swept from its foundation and most of the *débris* carried to the SW. and S. In the orchard on the W. side of the house the trees were thrown to the SW., SE. and E. The cellar was filled with stoves, plows, cultivators, and broken timbers, except the NE. corner, in which very fortunately, the family, six in number, had secreted themselves. The *débris* was piled up about them like corded wood. Two hogs were found in the cellar quietly eating sweetmeats and drinking milk as if nothing had happened. They must have been carried there by the force of the wind, as it would have been quite an unprecedented feat for a hog to have jumped, voluntary, into a deep cellar. Two horses, weighing each about 1,200 pounds, were carried away from the W. side of the house, in a circle by the S. to the NE., one three-fourths of a mile and the other about half a mile. The former was carried across a creek running from NW. to SE., and when first seen after the storm was walking about in a very irregular manner as if dizzy, but not otherwise affected by his journey. The other animal was not seriously injured, but no one noticed his actions during or following his transportation. Along the path in which the horses were taken, several places were observed where their feet plowed the ground to a depth of 5 or 6 inches. One of the neighbors stated that a sulky-plow, standing E. of the house and weighing several hundred pounds was driven through the N. side before the building went to pieces. It must have been carried in the whirl of the cloud from right to left, as the direction of the *débris* from the house would indicate. One-fourth of a mile W. of Mr. Bishop's stood the house of Mr. Robert Rollings, from which only the roof was taken and carried to the E. Mr. Joseph Morris, half a mile W. of Rollings's, or three-fourths of a mile from the storm's center, reported a strong westerly wind while the storm was passing, and a strong current from the S. following the storm. Dr. Davis, 45 rods WNW. of Mr. Bishop's, had his house violently shaken but not destroyed. The shed and stable 100 feet E. of the house were torn to pieces and the *débris* carried to SWS. and SE. One of his horses was carried from the earth to such a height that upon reaching the ground its legs were broken and ribs crushed in, resulting in death.

The tornado was now within $1\frac{1}{4}$ miles of Delphos, which stood to the W. of the storm's center. Not the least damage was inflicted upon any portion of the town, as will be seen from the following statements of some of the residents who witnessed the storm for a considerable time before and after it passed the town. Mr. George W. Stickler, postmaster at Delphos, stated that the tornado passed the town at a few minutes after 4 p. m. First saw the funnel-shaped cloud about 8 miles S. of Delphos moving to the NE. After crossing the river it bore more to the N., passing the town about 1 mile to the E. When the cloud was first observed it appeared to be moving forward at the rate of about 10 miles per hour, but the velocity of the whirl within the funnel was beyond all comparison or estimation. The clouds above the funnel were moving from all directions toward it, and when near its circumference would then rush downward and disappear within its center, apparent y

moving upward through it to the top. About ten minutes before the storm passed, there came a small shower of rain and hail with a gentle southerly current. The hailstones were at first quite plenty but small, rapidly increasing in size as they diminished in quantity. Some measured 15 inches in circumference, one side being flat and the other oval. Others were jagged and about the size of a man's fist. The hail and rain entirely ceased after the storm passed the town. While opposite the town, Mr. Stickler judged the funnel to be about 30 feet wide at the bottom, spreading out gradually up to a height of several hundred feet, when it embraced a dark overhanging cloud, covering one-quarter of the heavens. No strong wind was felt before, during, or after the passage of the tornado. Mr. W. A. Kiser, of Delphos, was out in his fields sowing grain a short time after daylight. As the day came on, a brisk wind from the SE. set in, which continued until rain and hail occurred about 3 p. m. Most of the rain came with the small hail which fell first, but the raindrops were very large and scattering when the hail became larger, and both seemed to fall straight down. No damage of any kind was committed in the town. Mr. B. F. Billingsley, of Delphos, kindly furnished me this very interesting letter, which I take pleasure in giving in full:

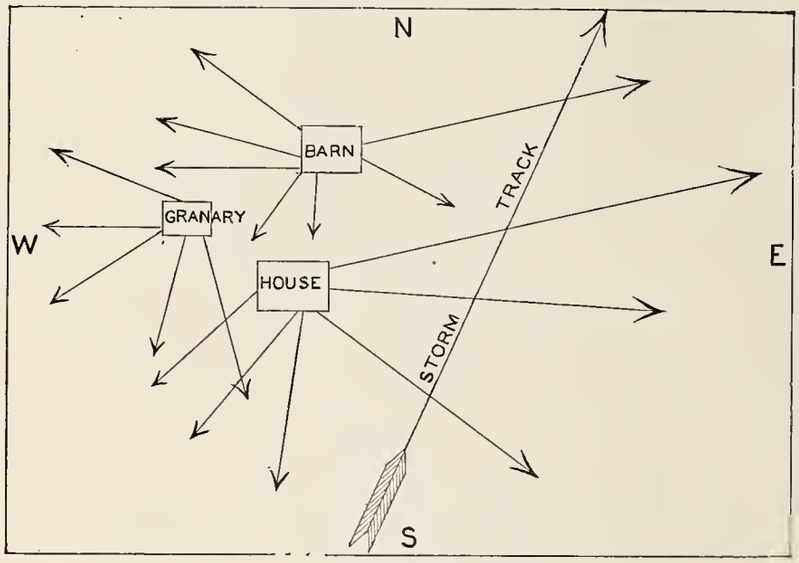


Diagram No. 9.

On Friday morning, May 30, 1879, the wind was blowing from the SE., threatening rain. High temperature; sky overcast with clouds; steady wind all day until about 3 p. m., when it commenced raining, accompanied with hail which rapidly increased in size, several of which measured 12 to 15 inches in circumference and 1 to 2 inches in diameter. When the hail began to increase in size, the wind lulled and it was almost perfectly calm. The large stones seemed to drop almost perpendicularly. During this calm I noticed a commotion among the clouds in the SW., on the S. side of the Solomon River. The clouds would rush together, then separate, finally coming together again with the most dreadful contortions, evolutions, and twistings. Long points shaped like a cow's horn would reach toward the earth. The cloud now commenced a rapid revolving motion from right to left, the center reaching downward toward the earth in the shape of a funnel, and its awful roar could now be distinctly heard like distant thunder. The dark, inky, funnel-shaped cloud rapidly descended to the earth, which reaching, it destroyed everything within its grasp. Its whirling motion from right to left was inconceivably rapid, displaying irresistible power. Nothing could stand before it. Everything was taken up and carried round and round in the mighty whirl of the terrible monster. The surrounding clouds seemed to roll and tumble toward the vortex. The funnel now extending from the earth upward to a great height was black as ink, excepting the cloud near the top, which resembled smoke of a light color. Immediately after passing the town, there came a wave of hot air like the wind blowing from a burning building; it lasted but a short time. Following this peculiar feature, there came a stiff gale from the NW., cold and bleak, so much so that during the night frost occurred and water in some low places was frozen.

After leaving Mr. Bishop's the storm bore still more to the NE., and at the distance of 1 mile destroyed the house and out-buildings of Marshall Davis, standing 20 rods W. of the storm's center. (Diagram No. 9.) The *débris* of the buildings was carried to the NW., W., SW., SE., and NE., and scattered over about 80 acres of ground. A sill from the house, 6 by 8 inches, and 10 feet long, was found 160 rods to the NE. Several slabs, 10 inches wide and 4 inches thick, were found 150 rods in the same direction. The coupling pole of a lumber wagon with the iron castings upon it was found 230 rods to the N. Tin sheeting and boards were found along the track for a distance of 3½ to 4 miles. The top of a stove, weighing 50 pounds, was carried one-fourth of a mile to the E.

Mr. Joseph Courtney, 160 rods NNE. of Mr. Davis, and 30 rods W. of the storm's center, was next visited. The house was completely torn to pieces and the *débris* carried in almost a complete circle from right to left, scattering it over about 100 acres. A stable, 18 by 20 feet, and 14 rods NW. of the house, together with a shed and granary, distant about 6 rods, were first destroyed, and the *débris* carried over the top of the house, which followed after, its fragments being carried

in the manner above indicated. Three colts grazing in a pasture, inclosed by a hedge fence, situated 20 rods NE. of the house and a short distance W. of the storm's center, were carried S. into an adjoining wheat field, and then about in a circle to the E., NE., and NW., back into the pasture again. (Diagram No. 10.) Their path was clearly identified the next morning by holes plowed in the ground with their feet and the several openings in the hedge fence where they were driven through. In the wheat field there were indications that the animals had been rolled along over the ground, which was considered all the more probable from the fact that they were covered with mud from head to foot. A calf picketed W. of the granary was dragged round and round at the full length of the rope, until it was strangled and badly mangled. A lumber wagon, which stood a few feet S. of the granary, was broken in two, and the fore wheels with tongue and hounds were carried 4 rods to the S. and wedged between two trees so tightly that the latter had to be cut down in order to secure their release. The hind part with the box was carried 30 rods to the SE. and torn to pieces; one of the wagon tires was found farther to the S. considerably twisted, and the other carried to the E. The axle and hubs, divested entirely of spokes, were found half a mile to the NE. Not any two of the spokes or fellies were found lying together. (Diagram No. 11.) A large two-horse cultivator west of the granary, and weighing between 200 and 300 pounds, was torn to pieces, and the fragments carried in a circle to the N.

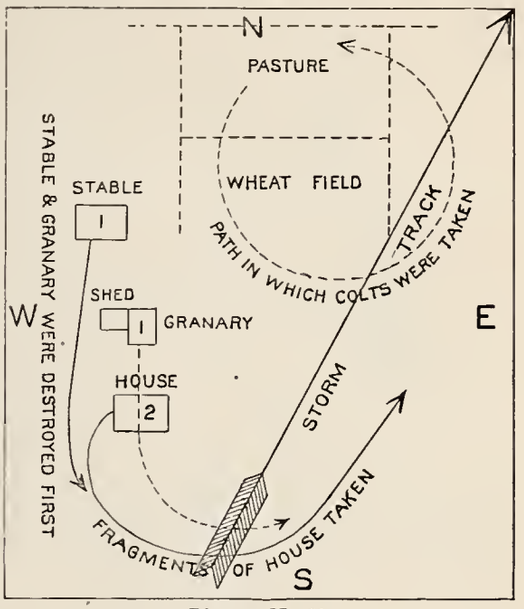


Diagram No. 10.

Half a mile NNE. of Mr. Courtney's, and upon the open prairie, stood the house and stable of Mr. James Dinwiddie, 15 rods W. of the storm's center. Both buildings were swept from their foundations, and the fragments carried to the W. and S. Various farming implements, such as wagons, plows, and cultivators, were rendered completely unserviceable. The large stone house of Mr. J. A. Ostrander, 30 feet square and two stories high, situated three-fourths of a mile NE. of Mr. Dinwiddie's and 40 yards E. of the storm's center, was unroofed, and the *débris* carried to the NE., N., and NW. The walls were badly torn down, destroying nearly the whole of the second story. A hired man standing in the W. door of the house was carried 50 yards to the NW. and lodged in a small creek, considerably bruised. (Diagram No. 12.)

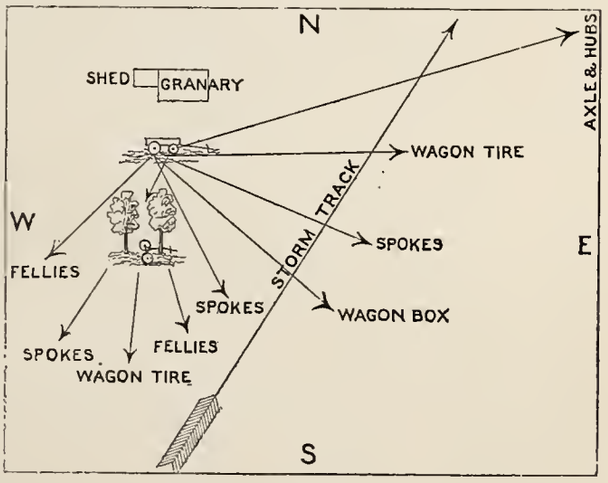


Diagram No. 11.

The storm now commenced the ascent of the bluffs forming the eastern boundary of the Solomon Valley, and, at the distance of 1 mile N. of Mr. Ostrander's, unroofed the house of Milo Basnett, which stood one-quarter of a mile E. of the storm's center. The *débris* was carried to the NE. and the body of the building severely wrenched, but not moved from its foundations. A young man standing within the house when the roof was taken off was whirled about and lifted from the floor several times. One-fourth of a mile to the NNE., and at the base of what might be called the line of most rapid ascent, stood the ("dug-out") house of Mr. J. H. Hane, the last building in the course of the storm. Just before reaching the house the funnel seemed to lift from the ground and pass directly over it, taking off the roof and badly wrecking a thrashing-machine which stood near. The *débris* was all carried up the bluffs in the course of the storm to the NE. The funnel cloud now passed to the summit, where it threw down a stone monument made of large bowlders said to have been placed there by the Indians. A short distance farther, and the cloud

crossed the northern line of Ottawa County, a little W. of its center, entering upon the high prairie over which it was seen to pass, a distance of 4 or 5 miles, greatly diminished in size and rapidly disappearing in the overhanging clouds. During a portion of this distance rubbish of all kinds was dropped to the ground over a width of from 60 to 80 yards. About twenty minutes before the tornado reached the bluffs a heavy storm of rain and hail passed to the N., cooling the atmosphere very perceptibly. The dark and heavy clouds accompanying this precipitation could still be seen in the distance, as the funnel lifted from the earth, and to all appearances eventually lost its identity therein. The entire length of the storm's track, embracing those portions at either end when the funnel was above the ground, was 42 miles, and the time occupied in passing over it one hour and twenty-five minutes, or about 30 miles per hour. This velocity is calculated upon the supposition that the funnel cloud was first seen at 3 p. m., passed Delphos at 4 p. m., and disappeared beyond the bluffs at 4.25 p. m. Mr. Ostrander considered the time as not far from 4.15 p. m. when the storm reached his house, 5 miles NE. of Delphos, which would make the velocity 20 miles per hour for that portion of the track. But all persons who watched the storm were unanimous in the assertion that it traveled much faster over the portion of the track S. of Delphos. The general course of the storm was from SSW. to NNE.

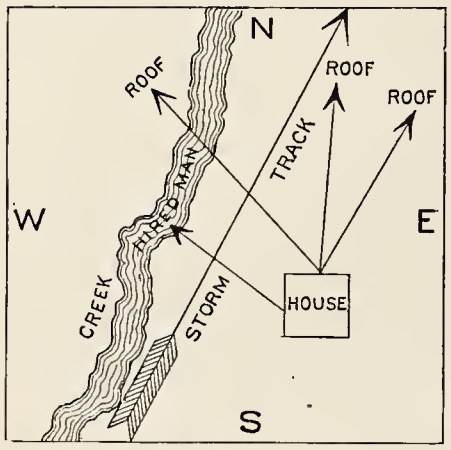
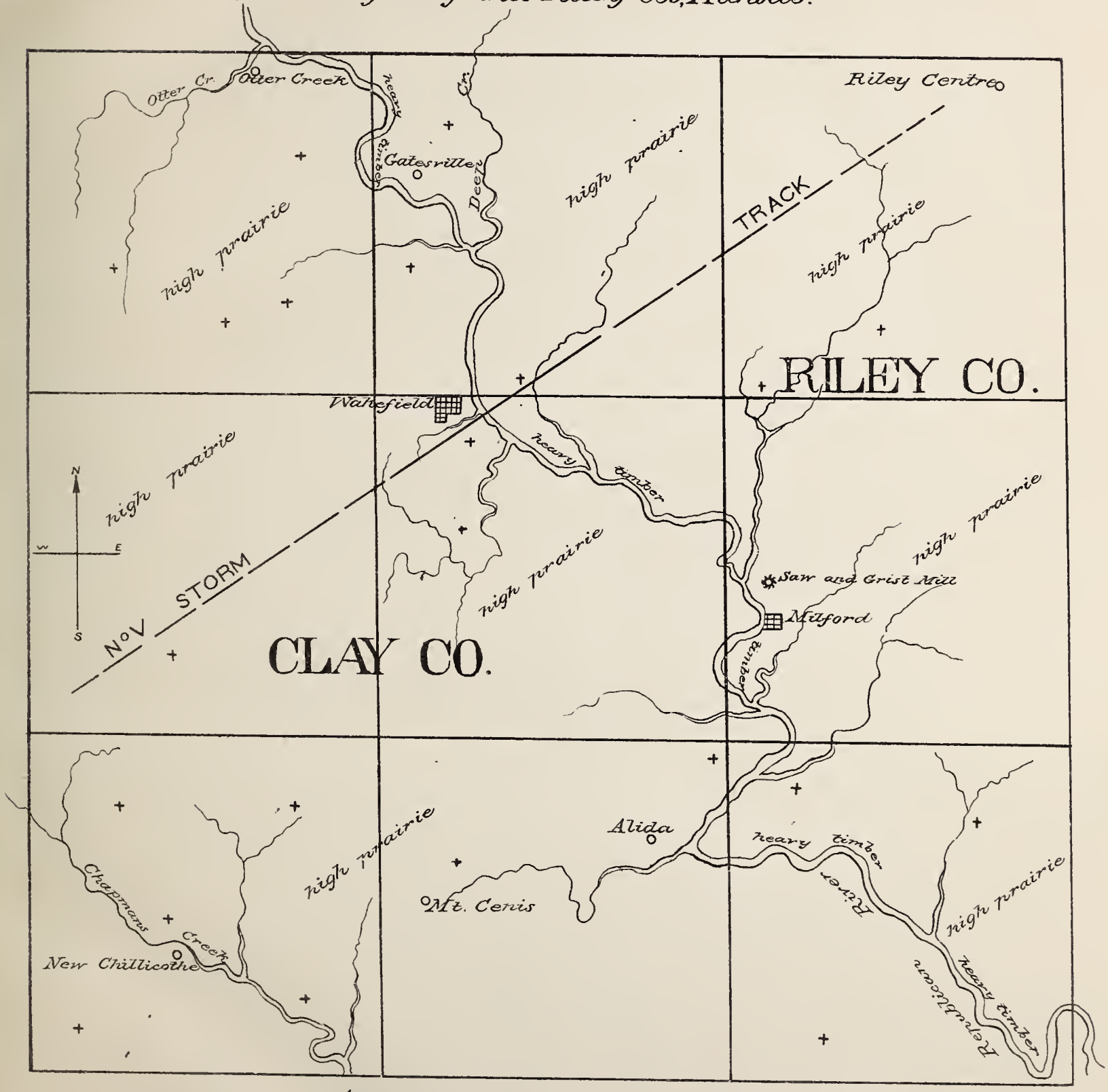


Diagram No. 12.

THE WAKEFIELD TORNADO.

About 5 p. m. on the afternoon of May 30, the inhabitants of Wakefield were startled by the appearance of a very strange and angry looking cloud in the SW., shaped like the trunk of an elephant. The day had been warm and sultry, with a southerly wind. About 3 p. m. threatening clouds appeared in the W. and SW., attended soon afterwards by rain and hail. Although the clouds at first presented nothing unusual in their approach, it was soon discovered that those in the SW. were darting hither and thither, and tumbling about in a very novel and portentous manner. From this seething mass of clouds the funnel was seen to dart downward, in the neighborhood of Chapman's Creek, about 8 miles SW. of Wakefield. The cloud remained above the earth while passing over the SW. and central portions of Republican Township, but finally descended to the high prairie about 1½ miles WSW. of Wakefield, reaching soon after a small creek which runs eastward along the southern boundary of the town, and empties into the Republican River. Where the cloud first reached the surface no evidence was left of its track, as it was upon the open prairie, presenting no material for destruction, but upon reaching the southern edge of the town, several houses were blown down over a path averaging nearly 300 yards in width. The Sentinel, a paper published at Minneapolis, Ottawa County, Kansas, reported on June 13, as follows: "At Wakefield considerable damage was done by a tornado. Eleven buildings were either injured or destroyed. Three persons were severely hurt, and a fourth fatally, the latter being Mr. Joseph Polly. The building in which he was living at the time of the storm was shattered to pieces." Ex-State Senator H. P. Dow, United States revenue collector, Manhattan, Kans., stated that while traveling through Wakefield on June 12 he came upon the track of the tornado of May 30, where he saw several buildings terribly shattered, while others were only unroofed or slightly injured. The latter seemed to be situated on the northern extremity of the storm's path, where to all appearances its fury was greatly diminished. The direction of the storm's course he considered to be from WSW. to ENE., and its length about 13 miles. After crossing Republican River it entered Grant Township, Clay County, passing over the prairie 1½ miles to Timber Creek, where it destroyed the heavy timber with great violence. At this point in the storm's course very strong evidence existed of a powerful whirling motion of the clouds, as the trunks and limbs of the trees were twisted and broken in a frightful manner. After passing Timber Creek, where its path was about one-fourth of mile wide, the cloud struck the high rolling prairie of Madison Township in the adjoining county of Riley. Here its path narrowed considerably, and after traveling a mile or

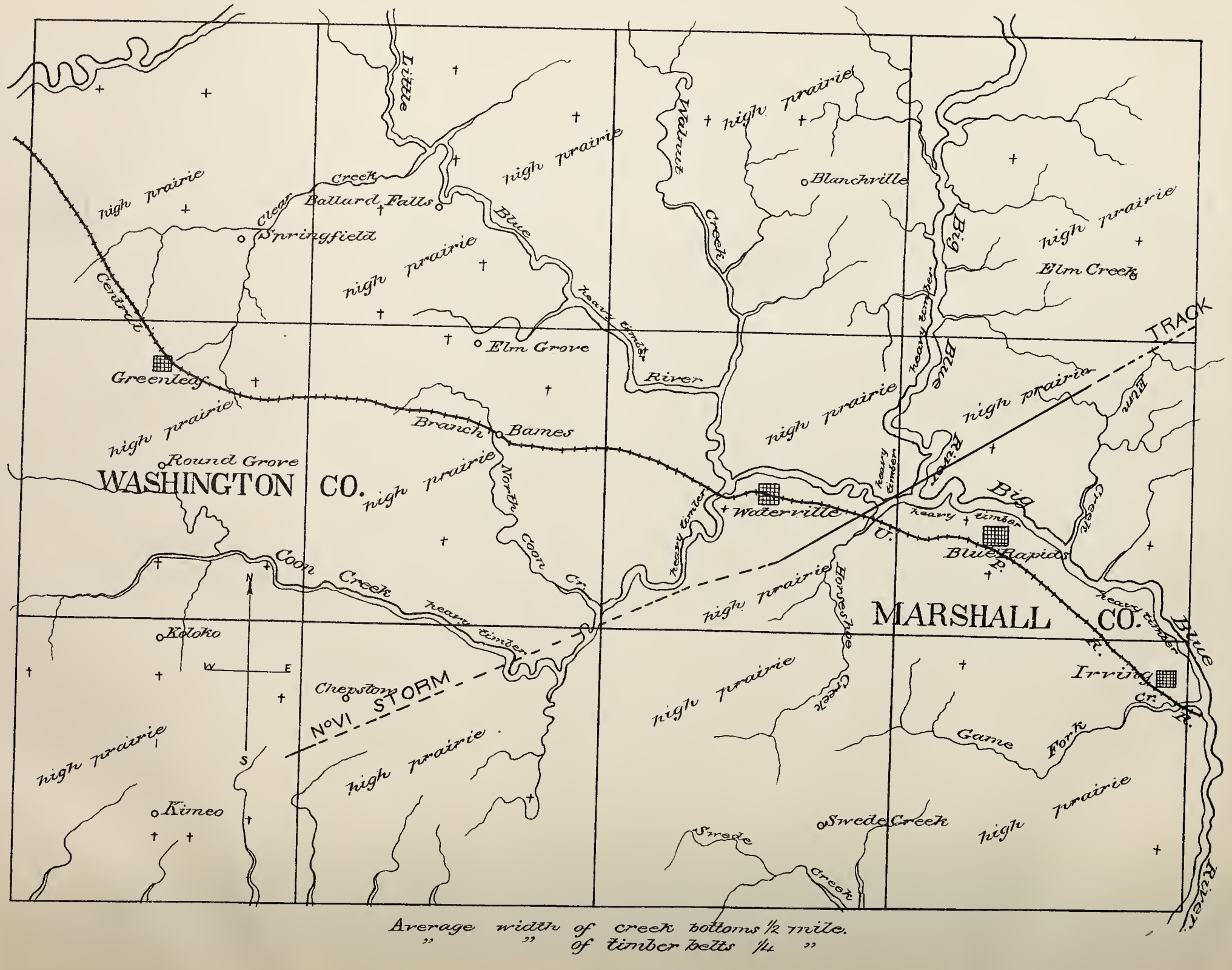
Exhibit A.
Map of the Track of the "Wakefield Tornado".
Portions of Clay and Riley Co's, Kansas.



Average width of bottoms ¾ miles.
Timber belts from 10 rods to ¼ mile.

Exhibit A.

Map of the Track of the "Waterville Tornado".
Washington and Marshall Counties, Kan.



Average width of creek bottoms ½ mile.
" " of timber belts ¼ "

more it rose from the surface and disappeared in the clouds. The Stockdale tornado, which occurred in the next township to the E., was not a continuation of this storm, because it formed about two hours later and at a point about 15 miles SE. of the terminus of the latter.

THE WATERVILLE TORNADO.

This storm was first seen to form over the various branches of Coon Creek, in the eastern portion of Lincoln Township, Washington County, Kansas, on the afternoon of May 30, at about 6 p. m. The surface of the township is gently undulating and well watered, being traversed in almost every direction by small and heavily-wooded streams. The bottoms are from one-fourth to three-fourths of a mile in width, rising in gradual ascent to the "divides" on either side. From its inception to a point S. of Waterville, a distance of about 7 miles, the tornado passed over the rolling prairie, leaving no evidence of its course, being at too great a height above the surface. All along rain and hail preceded it, while it was accompanied by a strong SW. wind, which was succeeded several minutes later by a cold current from the NW. In a letter dated May 31, and addressed to the Chief Signal Officer, by Mrs. C. B. Phillips, sunset observer at Waterville, she stated that at 4.45 p. m. of the 30th heavy rain commenced with a southerly wind, lasting until 5.30 p. m., when it ceased for about fifteen minutes, succeeded by a furious wind from the SW., tearing up sidewalks, destroying awnings and signs, and unroofing several barns and houses. The clouds were very dark and portentous in the SW., and rolled with great rapidity to the NW. In about twenty minutes the wind shifted to the W., continuing with a steady force for about fifteen minutes, when there were indications of an opposite movement from the NW. The clouds, dark and heavy, came up very rapidly, approaching those moving from the SW. At the junction of the two opposing currents, a cloud about the diameter of a barrel and apparently 100 feet in height formed, darting downward with an alternate rising and falling motion. The body of the curious cloud was of a very light color, while the top presented a decided contrast of a dark green shade. As the funnel, still a considerable height above the ground, passed by about 1 mile to the S., the wind blew stronger than ever from the SW. with rain and hail for about fifteen minutes, when it shifted to the NW., growing colder and still blowing very violently, the rain continuing. At 7.30 p. m. the high wind ceased and at 8 p. m. rain and wind ceased altogether. Since the 25th the temperature (taken at about 7 p. m.) had ranged from 82° to 93°. On Friday morning and afternoon it was still very sultry, but at 7.45 p. m. the temperature had fallen from 90° to 78° during the prevalence of the NW. wind, and, twenty-four hours after, to 51°, the wind then changing to the NE. After leaving Waterville the storm passed up Horse Shoe Creek to the NE. a short distance, crossing it about 1 mile S. of where it empties into the Little Blue. It then moved to the mouth of the Little Blue, $1\frac{3}{4}$ miles NW. of Blue Rapids, and descended to the ground for the first time on the eastern bank, destroying the partly finished frame house of Mr. Sawyer, who, at the time, was engaged with carpenters putting on the roof. The storm struck it a few minutes after 6 p. m. The cloud was preceeded about fifteen minutes by a SW. wind with rain and hail, the latter unusually large. It could be seen for a distance of about 3 miles to the SW., well defined, of the shape of a funnel, about the size of a man's body, and several hundred feet above the ground. As it drew nearer the cloud worked itself gradually downward in a twisting manner towards the earth, reaching it about 60 rods W. of the house, which was instantly demolished by a strong SW. current. The *débris* was carried to the NE. and N. One of the carpenters standing on the W. side of the building was blown into a ravine 70 feet to the NW., breaking his arm. After leaving the house the cloud cut its way through the heavy timber bordering the Little Blue, crossing the stream near where it empties into the Big Blue, and thereafter crossing the latter. For a distance of half a mile and a width of from 200 to 300 feet a path was cut through the timber bordering these streams, where the storm made its usual havoc, twisting off the tops and bodies of large trees and uprooting others. One and a fourth miles NE. of Mr. Sawyer's house, and in the center of the storm-track, pieces of boards from the ruins were found driven into the ground in a complete circle, having a diameter of about 30 feet. This fact was reported to me by Mr. James Patterson, of Irving, who passed over the track directly after the storm. At Blue Rapids, $1\frac{1}{4}$ miles SE. of the storm's center, a strong wind was felt from the SW. as the cloud passed, but no serious damage was done. About three-quarters

of an hour previous, and while the strong W. wind was prevailing at Waterville, an equally violent NW. wind, with rain and hail, unroofed the woolen and gypsum mills, overturned small outbuildings, and caused other damage. After leaving the Big Blue, the cloud rose to a considerable height above the ground and moved in a northeasterly direction towards the head of Elm Creek, passing through portions of the townships of Blue Rapids and Elm Creek, where, in all probability, it disappeared in the clouds, as nothing was afterwards heard of it. During its passage over these townships the cloud was preceded by rain and hail, with a southerly wind, which was immediately succeeded by a strong SW. current of sufficient force to overturn small out-buildings and destroy fences. This change of current to SW. was in a few minutes followed by a cold NW. wind, with light rain. The entire length of the storm's track, including those portions where the cloud was above the ground, was about 13 miles. Its course was from WSW. to ENE. Respecting its velocity of progression, I am unable to furnish any data, except the mere statement of parties at Mr. Sawyer's that it moved at the rate of about 20 miles per hour, with a gyratory motion inconceivably rapid.

LINCOLN COUNTY TORNADO.

While at Minneapolis obtaining information respecting the Delphos tornado, I heard of this storm in the adjoining county of Lincoln, and made preparations to proceed on the following morning to commence its investigation, but during the night a heavy rain storm set in which continued during the next day, washing away bridges, converting streams into rivers, and rendering it impossible to make the journey by any available or ordinary means of transit until after the expiration of several days. In connection with an examination of the storm's path I received a very kind and valuable letter from Capt. L. W. Metcalf, of Monroe, whose house, standing on an eminence 1 mile E. of the storm's center, afforded an excellent opportunity from which to watch the formation and progress of the tornado. Captain Metcalf traveled very carefully over the path of the tornado three times, being interested in obtaining a knowledge of its peculiarities, and also as a member of the relief committee appointed to ascertain the condition of the sufferers, and to solicit aid for their protection and support. This tornado was one of a series of seven which occurred on the afternoon of May 30 in the central portion of Kansas, over what is called the 2,000-foot level; that is, the elevation compared with the sea-level. During Friday the weather was very warm and partially cloudy, with southerly winds, which condition had existed for eight or ten days. At 2 p. m. dark clouds were seen to gather in the SW. and NW., at what appeared to be a distance of from 12 to 14 miles to the westward, rain and hail commencing soon after, with a strong S. wind backing to the SE., and then quickly veering to the W. and NW. At first the hail stones were about the size of marbles, but they rapidly increased in diameter until they were as large as hens' eggs and very uniform in shape. After the precipitation had continued about fifteen minutes the wind ceased and the small hail nearly stopped, when there commenced to fall perpendicularly large bodies of frozen snow and ice, some round and smooth and as large as a pint bowl, others inclined to be flat with scalloped edges, and others resembled rough sea-shells. One

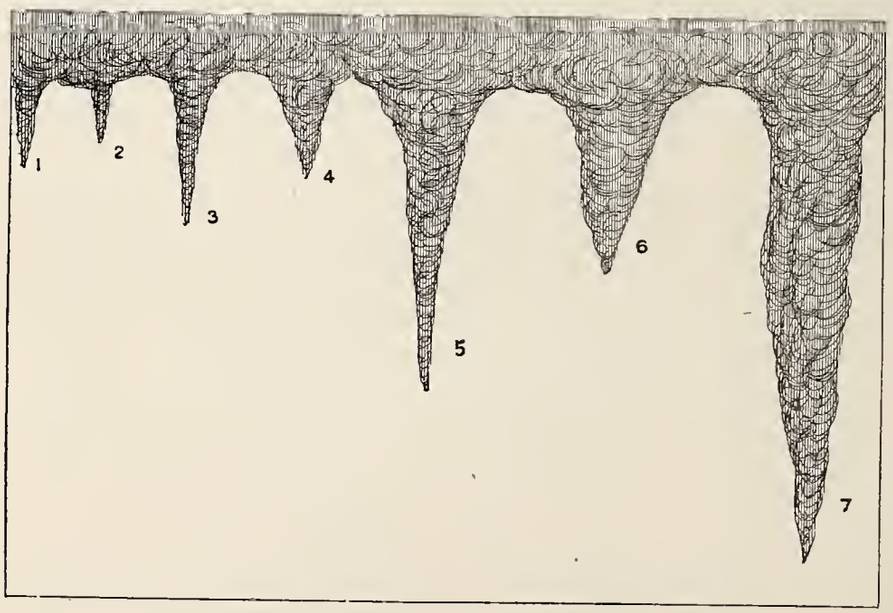
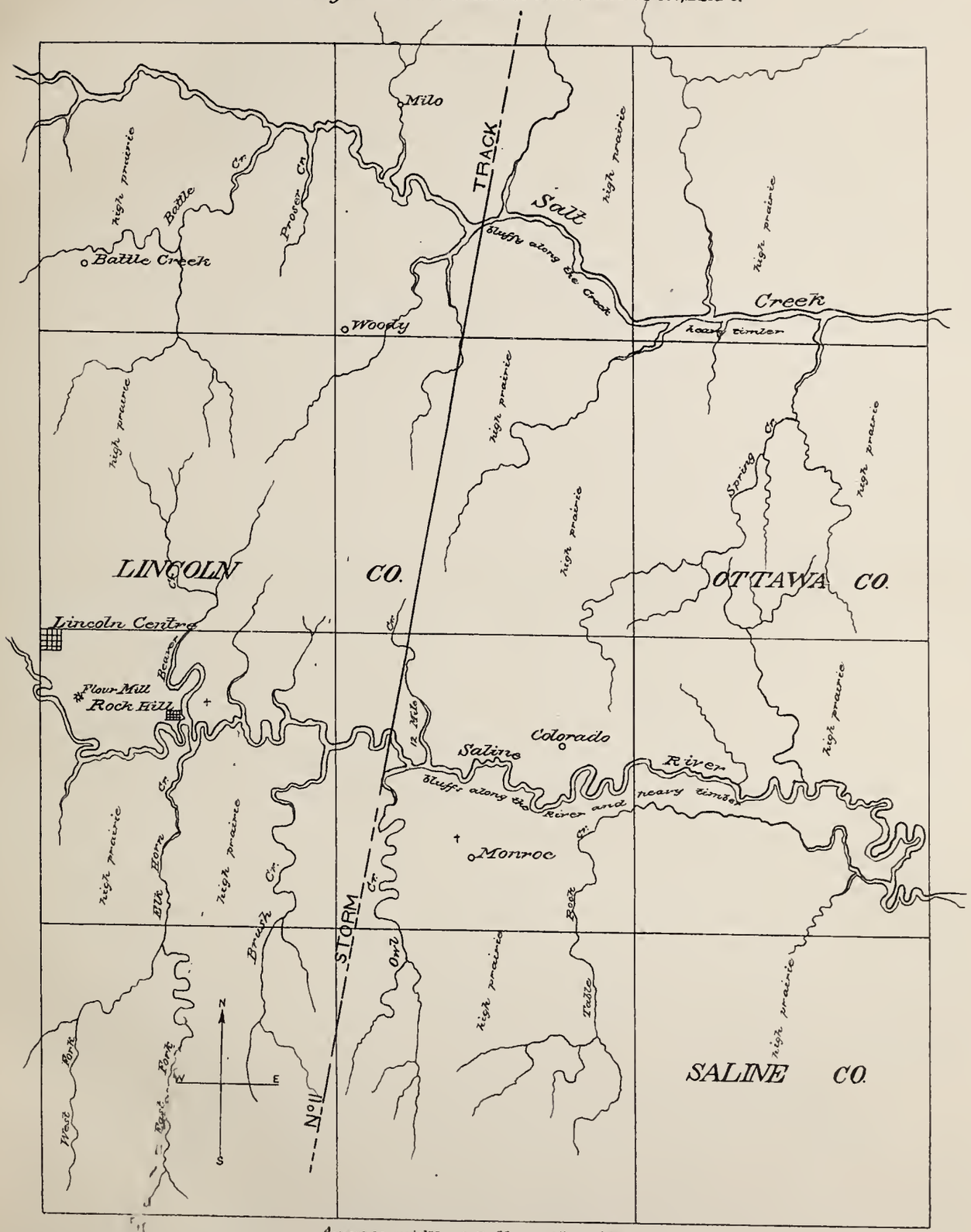


Diagram No. 1.

Exhibit A.
Map of the Track of the "Lincoln County Tornado."
Portions of Lincoln, Ottawa and Saline Co's, Kan.



Average width of bottoms 1½ miles.
Timber belts ¼ mile in width.

of the latter after being exposed an hour to the sun measured 14 inches in circumference. At 2.30 p. m. the clouds in the SW. were seen to be in terrible commotion, some rising and descending, some whirling about, and others darting with lightning rapidity towards a common center. The NW. cloud at this time had nearly united with the one in the SW., and soon there was discovered a small, narrow, funnel-shaped cloud descending from a point, which, to all appearances, formed the junction of the two clouds. While it rained and hailed the air was quite cool and pleasant, but as the tornado passed it suddenly became so oppressive that it was difficult to breathe. On the outer edges of the storm there was almost a dead calm, and the flying *débris* which was thrown from the top of the funnel came down in straight lines. The funnel, upon making its appearance, would descend a short distance from the cloud and then draw itself back almost the entire length. (Diagram No. 1.) It continued this rising and descending motion, each time falling lower and growing larger and nearer, until it reached the ground. The great commotion in the clouds, spoken of before as occurring previous to and during the incipient stage of the funnel, ceased when the funnel assumed complete dimensions, all of the disturbance being confined to the tornado cloud alone. The funnel cloud first formed 7 miles S. of the Lincoln County line, near the headwaters of Mulberry Creek, in Ellsworth County, and in crossing the creek some distance to the N., sucked up quite a large volume of water. It then encountered the house of Dr. Boyle, unroofing it and deluging furniture and clothing with water; loss, $300. Mr. Rose, near the line of Lincoln County, had his stable entirely demolished, and Messrs. McNamara and Stover, just across the line, had their houses unroofed. The bottom of the funnel had not yet reached the earth, as will be seen from the manner in which the buildings were injured, only the roofs being carried away. The high range of hills, called the "limestone bluffs," were then reached, over which the funnel passed, sweeping the ground until the house of Mr. Rogers was reached, just under the edge of the hills on the northern side. The roof was taken off and clothing with some of the furniture drawn up into the cloud. The articles so disappearing were never seen or heard of afterwards. A farmer (name unknown) driving along upon the road, and about in line with the storm's center, was caught up by the wind and carried out of his wagon a distance of several rods, breaking his arm. The wagon was completely torn to pieces and scattered in every direction. The harness was stripped from the horses, and one of them slightly injured. Mr. Albright's large frame house, containing two families, was next demolished. No one was killed, but Mr. Albright was severely injured. Here the funnel first reached the ground and began in earnest the performance of its most powerful and characteristic work. Mr. Green's house, near the head of Owl Creek, was completely swept from the ground, hardly leaving a vestige of anything to mark its original position. The father and three children were severely injured. Mr. Moore was located 200 yards W. of the storm's center, and his house, 12 by 30 feet and one and a half stories high, was lifted bodily and carried, with the entire family in it, to the center of the track, in a direction a little S. of E., where it went to pieces. None of the family were injured. A horse of Mr. Hortman's, standing outside of the stable and on the W. side of the storm's center, was carried one-fourth of a mile to the SW., nearly killing it, both of its eyes being destroyed by contact with flying *débris*. Mr. Valentine's house farther up the creek, was a large structure, built of limestone. The roof was taken off, and everything movable was blown out of the doors and windows and through the top. The family escaped by rushing into a "dug-out" as the storm came up. A new and heavy lumber wagon, standing near the house, was completely wrecked. The tires were stripped from the wheels, and either bent out straight or twisted into knots, and the hubs stripped of every spoke.

After overturning the granary of Mrs. Washam, on the western edge of the storm track, the funnel cloud struck the house of Mr. George A. Myers, 12 by 18 feet and 1½ stories high, made of magnesia limestone, with walls 16 inches thick. The roof was made of heavy cottonwood poles and covered with 12 inches of black dirt and clay. The ridge-pole was 18 inches in diameter and 18 feet long. The building was whirled into a shapeless mass of rubbish in almost an instant. Large stones weighing from 150 to 200 pounds were carried from 75 to 100 feet. There were five persons in the house at the time, all of whom were severely injured, but only one killed, a little boy eighteen months old, who was found with not a bruise upon his body, yet with life extinct. The width of the path of greatest destruction was 40 rods, yet even at the distance of 1½ miles E.

of the storm's center the wind was strong enough to blow down the house of Mr. Parker and tear his wagon to pieces, causing altogether a loss of $600. One mile NE. of Mr. Myers stood the house of Henry Hartman. It was made of heavy limestone rocks, but was razed to the ground, as was also his stone granary. Everything within the house was rendered unserviceable; clothing was torn into shreds, and furniture and dishes broken to pieces. Mr. Kane, 80 rods E. of Mr. Hartman's, and E. of the storm's center, had the W. end of his stone barn blown away, and also all of the lumber he had purchased for building a new house. At this point the tornado raised from the ground and descended one-fourth of a mile farther on in the wheatfield of Mr. John La Bar, whipping the heads of wheat from the stalks and beating the latter into the ground. One-half mile to the NE. the cloud struck his house, distributing the *débris* for several miles over the prairie. The structure was built partly of logs and boards and covered with a shingle roof. Some of the logs, 16 feet long and 10 inches in diameter, were carried 40 rods. The family sought shelter in a stone smoke-house close by, but even that did not escape complete destruction. Mr. La Bar had his arm broken, and his hired man received severe injuries upon the head. All of his farming implements, among which were a new reaper and steam thrasher, were damaged beyond any manner of use; loss, $2,000. Mr. Elam La Bar, who lived 35 rods to the NW., had the roof of his house taken off and the contents scattered about the prairie. East of his house a short distance, and near the storm's center, stood the stable, in which were tied a pair of medium-sized horses. The building was blown to pieces and the horses carried over an adjoining wood-pile and into a wheatfield 80 rods to the SE. Mr. Landers, a neighbor, vouches for the truth of this statement. He would not say that the animals did not touch the ground during the entire distance, but that there was no evidence of such a fact, and from the terrific force the storm manifested at this point, and other places, he did not consider it more extraordinary than many other evidences of its violence. The storm next reached the Saline River, near the mouth of Owl Creek, where it destroyed the granary and stable of Mr. W. L. Gillmore, who was situated on the W. side of the storm's center. His house escaped with slight damage, being on the extreme western edge of the storm. As it crossed the river it mowed a swath through the timber from 75 to 250 yards in width. (Diagram No. 2.) The largest trees were broken off near the ground, while small trees, with a tough, elastic fiber, were twisted into ropes. Here was undisputed evidence of the whirl of the cloud from right to left, easily detected in the twisting of branches and the trunks of the smaller trees. On the N. side of the river, and E. of the storm's center, the house of Mr. Bloomheart was destroyed and the *débris* carried along the track to the NE. Mr. Hordesty, who had lately transported a large quantity of lumber and considerable machinery to this point of the Saline River, preparatory to the construction of a flour mill, found his machinery broken to pieces and the lumber converted into kindling wood and scattered to the winds; loss, $1,700. Several reliable persons, who secreted themselves in the curve of the river near the mill-site to escape the fury of the storm, stated that as the funnel passed over the water was sucked up to such a degree that the bed of the river was exposed. There were no means of verifying this statement from any resulting action of the funnel after the occurrence, as there was no evidence given of its depositing any large volume of water further on in its course. It may not have taken much, if any water from the river, but through the display of its terrific whirling power, have driven the waters back each way, thus exposing to view the bottom of the river, as was the case on the Big Blue at Irving. For a distance of 3 miles N. of the Saline River the tornado still continued to move along the surface, during which time three houses were destroyed and one person severely injured by falling timbers. It had then nearly reached the high divide between the Saline River to the S. and Salt Creek to the N., over which it was seen to disappear, drawing itself up into the clouds above. Captain Metcalf stated that the strongest suction appeared to be on the E. side of the storm's track, which throughout the entire course was wider (that is, the area of destruction) than the W. side,

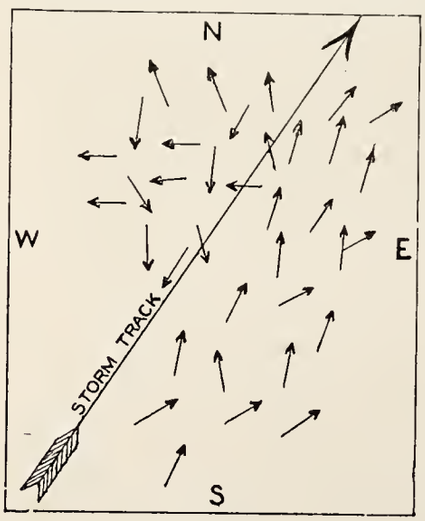
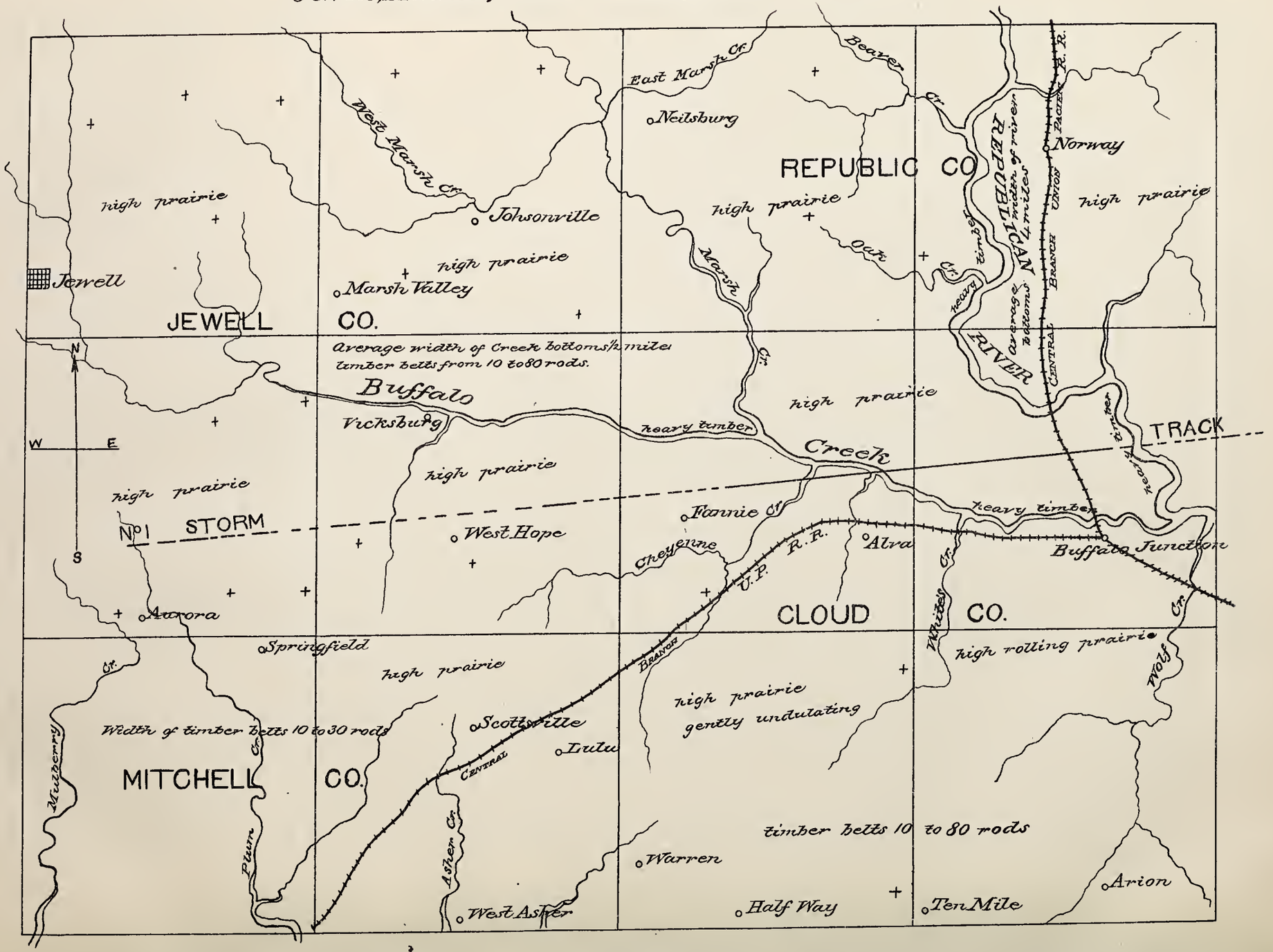


Diagram No. 2.

Exhibit A.

Map of the Track of the "Buffalo Creek Tornado"
Jewell, Mitchell, Cloud and Republic Co's, Kansas.



and furnished repeated evidence of strong inrushing currents from the S. and SE. The widest portion of the storm's track, meaning the path of greatest destruction, was at Mr. La Bar's, where it spread out to nearly 100 rods, but the wind was very strong on the E. side to a distance of 1 mile from the center. The width of the hail storm which preceded the tornado was in no locality less than 2 miles, and in many places it was 3 miles wide. The course of the storm was from SSW. to NNE. Commencing 7 miles S. of the Lincoln County line, the funnel cloud moved almost directly N. across it and up the entire length of Owl Creek to Saline River and across the latter, following the course of Twelve Mile Creek, bearing a little E. of N. It left this creek as it encountered the high divide, having completed a distance of 23 miles (9 of which were above the ground) between 2.30 and 3.30 p. m., showing the velocity of progression to be 23 miles per hour, or thereabouts. Over some portions of the track the storm traveled more rapidly than at others, especially when above the surface of the ground.

THE BUFFALO CREEK TORNADO.

The region over which this storm is reported to have originated, in the southeastern part of Jewell County, is traversed by no less than four creeks, the largest being called Buffalo, of which the others are tributaries. The general course is easterly, those branches from the N. running to the SE., and those from the S. running to the NE. The width of the bottoms, which are heavily timbered, vary from one-half to three-fourths miles, bounded by a gently undulating prairie, with gradual ascent from the streams. The following communication is from Mr. L. C. Preston, jr., who witnessed the approach of the storm from the small town of Scottsville, about 12 miles NE. of Beloit, on the Central Branch of the Union Pacific Railroad:

On May 30, between 3 and 4 p. m., my attention was directed to very threatening manifestations of the clouds in the NNW. Soon other clouds of a portentous character began to lift above the SW. horizon and approach the opposite formation. As the two sets began to cover the western horizon, the clouds commenced to roll and twist in a very strange and frightful manner. Their movements were made with lightning rapidity, presenting a sight which it had never been my opportunity to witness before. The disturbed clouds seemed ultimately to concentrate in one intensely black spot, a little N. of W., and over the high divide between Buffalo Creek to the N., and Fannie and Cheyenne creeks to the S. On this ridge the dark cloud seemed to divide, one part passing S. toward Beloit, and the other passing along Buffalo Creek toward Concordia, a little N. of E. The latter portion was more distinctly visible, and at times, as it came from behind belts of timber and ranges of hills, presented the features of a waterspout. I made up my mind that a terrible storm must be raging in the course of this cloud, and determined on the following morning to verify my presentiments. Upon reaching Buffalo Creek, where it strikes the northwestern corner of Cloud County, I found terrible destruction along the low banks of the creek. In traveling 4 miles I found five houses and the accompanying out-buildings completely wrecked. Heavy stone houses were torn down level with the ground, while straw sheds near by were unharmed. Roofs were blown from one-half to three quarters of a mile, and trees from 2 to 3 feet in diameter were either twisted, broken off near the ground, or uprooted. The width of the path of destruction varied from 50 to 80 rods, and its course seemed to be from WSW. to ENE. At times the cloud would follow very closely the bend of the creek, and then suddenly leave it. The people all along that portion of the track I visited concurred in their testimony regarding the funnel shape of the cloud, its whirling motion, and the almost instantaneous rapidity of its destructive action.

Several persons were seriously injured, but none killed. Mr. Preston further reported that a man came into Scottsville on the morning of the 31st from Phillips County, about 60 miles W., and stated that a terrible hail storm, accompanied by violent winds, passed through that county, from W. to E., on the afternoon of May 30, between 2 and 3 p. m. Buffalo grass was beaten into the ground, and hail stones gathered 5 feet deep in the small ravines.

Mr. Halliday, resident of Scottsville, watched the storm from its inception, and corroborates the testimony regarding its funnel-shaped appearance. This storm, no doubt, came very close to Concordia, as will be seen from the following statements of some of its most reliable citizens, and perhaps would have visited it had it not been for the peculiar topography about the town to the N., W., SW., and E. The town is situated about 2 miles S. of the Republican River, $2\frac{1}{2}$ miles E. of Wolf Creek, and $1\frac{3}{4}$ miles W. of Oak Creek, upon the Central Branch of the Union Pacific Railroad. Buffalo Creek empties into the Republican River $4\frac{1}{2}$ miles WNW. of the city. The banks of these small streams ascend gradually to form high ridges or divides of a mile or so in width, which again descend to the E., W., and S., resulting in a natural basin, where the thrifty town is cosily nestled. From all appearances it would seem that these ramparts of nature secured the

town against a terrible foe, the storm cloud appearing to divide or break up W. of the town, as in several other cases similar storms were reported to have done. Mr. B. H. McEckron, of the United States land office, furnished me the following information:

From about noon on May 30, the sky was overcast, a strata of light clouds running low from the SE. This continued until about 3.30 p. m., or possibly 4 p. m., with occasional distant rumblings of thunder, when suddenly it began to grow dark, and the darkness increased to such an extent that we could not see to write in my office without lamps lighted. At this time there was every indication of a severe storm. The light strata of clouds still continued to run with the lower current of the wind from the SE., while a very heavy, black, and angry-looking storm cloud was approaching from the NW., and another heavy storm cloud seemed to be moving directly from S. to N. I watched the black, threatening cloud in the NE. more closely than the one from the S., as it was the most likely to visit us, and looked far more dangerous than the one in the S. For some time it seemed to approach steadily, but finally it appeared to divide, or grow lighter to the left or W. of the center of the cloud, part going N. of us and a much larger portion going S. of this place. The latter was very heavy; the roaring which it made was distinctly heard at Concordia after the storm here had ceased. At Concordia, as the storm approached, the wind changed suddenly to the NW., and the storm of wind, rain, and hail was very severe, though no damage was done. Many of the hailstones here were nearly as large as hens' eggs.

Mr. J. S. Paradis, editor of the Concordia Exposition, writes:

During my observation of the approach of the storm which passed near Concordia, Kans., on the 30th day of May, 1879, I noticed a stratum of very thin, white clouds moving slowly in a westerly direction and very close to the earth, while above that a stratum of heavy, black clouds was moving rapidly with a rolling motion in opposite directions, some going N. and some going S. The wind during that time was blowing with great velocity from the NW. A short distance SW. of Concordia the clouds appeared to be moving in every direction. At every ten or fifteen seconds some of them would shoot up nearly out of sight, and others would descend almost to the ground.

Mr. J. D. Wilson, sheriff of Cloud County, resident of Concordia, reported that about 3 p. m. the appearance of unusually dark and heavy clouds in the NW. was noticed. For some time previous threatening clouds had been moving from the SW. and NW., the former most rapidly. Between 9 and 10 a. m. his chemical barometer indicated a violent disturbance in the atmosphere and the formation of a very heavy storm, as shown by the precipitation in the bottom of the tube, which kept in constant commotion, at times rising near the top. Proposed going to Delphos, but gave it up, although everything about the sky appeared favorable. We had had no storm of any kind for three or four weeks, which had brought on a severe drought. Wind had been in the S. for about two weeks, becoming at last almost as hot as a simoon. At 9 a. m. the temperature was 84°, rising to 91° by 1 p. m., when very heavy rain commenced, with large, scattering hail. The wind accompanying it did not seem to blow from any one direction, but rapidly-changing currents from the SE., SW., and NW. were experienced, attended with strange commotion in the clouds.

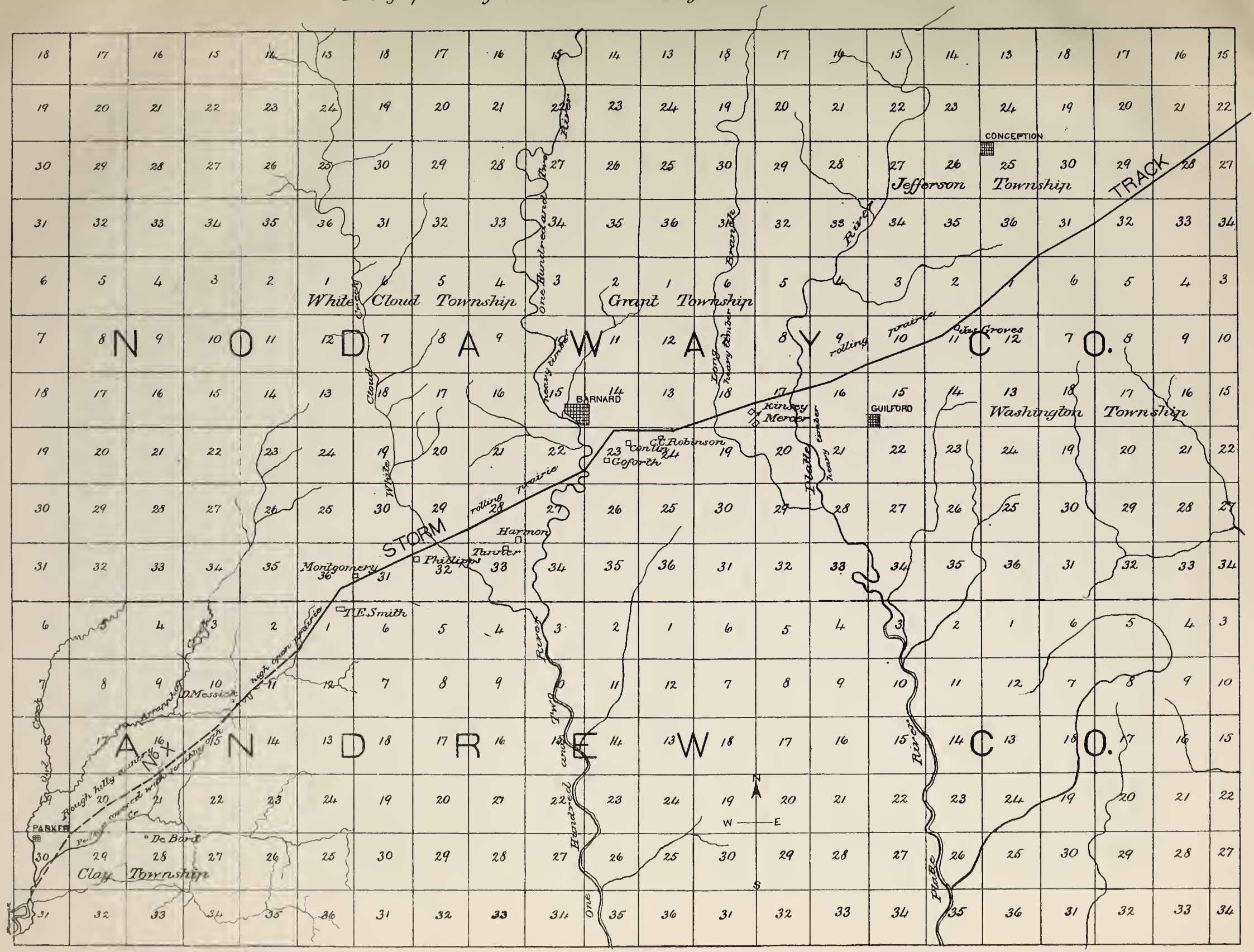
I obtained no reliable information regarding the length of this storm's course, or the rapidity of its progressive movement. It could not have been less than 12 or 14 miles long, and I presume from the severity of a portion of its course that its velocity of progression was not far from 20 or 25 miles per hour.

THE BARNARD TORNADO.

This storm first made its appearance as a funnel-shaped cloud, on the afternoon of May 29, in the southeastern portion of Holt County, Missouri, near where the southern boundary of Nodaway County strikes the Nodaway River. From this locality it pursued a NE. course through portions of Andrew, Nodaway, Gentry, and perhaps Worth counties. Previous to the formation of the funnel cloud there prevailed to the southwestward two heavy hail storms, as reported by Mr. William Kaucher, of Oregon, Mo., voluntary observer, Signal Corps, U. S. A. One of these storms passed N. of Oregon, Holt County, between 5 and 6.30 p. m., and the other passed S., between 4.20 and 4.50 p. m. With reference to these storms Mr. Kaucher stated that while out traveling to the northward of Oregon he encountered one of them moving eastward. Before the storm came up he had stopped for means of observation upon the high divide between the Nodaway and Missouri rivers, where the country could be easily seen within a radius of 30 miles. The Kansas timber on the opposite side of the Missouri could be clearly distinguished, and also dark and ominous clouds coming up suddenly, foretelling the approach of a severe storm at least 10 miles farther westward. The storm moved up very rapidly, attended by heavy thunder and lightning, and an unusual commotion in the clouds. Some of the hailstones were the size of hens'

Map of the Track of the Barnard Tornado.

Through portions of Andrew and Nodaway Counties, Missouri.



eggs. Just before the clouds passed to the E. of him he experienced an alternation of hot and cold puffs of air, from the SE. and NW. respectively, presenting a difference in temperature which was estimated at 20°. The interchange was not gradual, but painfully abrupt. As the storm passed to the SE., traversing the dividing line between Nodaway and Andrew counties, the commotion in the clouds became more intense, especially in the direction of Barnard, where the tornado passed shortly afterwards. On the 27th and 28th Mr. Kaucher reported at Oregon a continued southerly wind, with clear weather and a mean daily temperature of 75° to 78°. On the morning of the 29th a thunder shower prevailed, with a S. wind, from 10.55 a. m. to 11.25 a. m.; precipitation, 0.10 inch. At 2 p. m. the wind changed to SW., with a temperature of 82°, and at 9 p. m. to the SE., with a temperature of 68°, a fall of 14° in seven hours. At 4.20 p. m. a second thunder shower, but attended with hail, ended at 4.50 p. m.; precipitation, 0.06 inch.

Mr. George W. Coakley, editor of the Barnard Times, was, on the afternoon of the 29th, 12 miles NW. of Barnard, and about the same distance NE. of the point of Mr. Kaucher's observations. While traveling southeastward towards Barnard he encountered, about 3 p. m., a heavy storm of rain and hail, attended with thunder and lightning; wind from the WSW. The hailstones were the largest he had ever seen, but the precipitation was soon over. Before reaching home several short showers of rain and hail were experienced, cooling the oppressive air considerably. As Barnard was approached a deep, heavy roaring, like the rumbling of cars, was heard in the direction of the town, but could not at first determine its cause, as a dense timber belt obstructed the view; after reaching the town Mr. Coakley ascertained that it was caused by the passage of the tornado. Coexistent with the noise, an alternation of hot and cold puffs of air was experienced, which seemed to be a very strange occurrence, following the cooling effects of the late showers of rain and hail.

Mr. E. V. Leonard, who lives at Island City, 14 miles ESE. of Barnard, did not experience any storm during the 29th, except a light shower in the evening; wind SW. throughout the day.

These reports present rather briefly the extent and peculiarities of the general atmospheric conditions preceding the formation of the tornado, and would seem to indicate its very probable origin. Following the first appearance of the funnel-shaped cloud near the Nodaway River, and about 4 miles S. of where it strikes the northwestern corner of Andrew County, it passed northeastward at a considerable height above the ground, crossing Arapahoe Creek, about three-quarters of a mile S. of Parker. It now entered a rough, hilly section, covered with a scrubby undergrowth, together with some heavy timber, and divided into farms ranging from 40 to 160 acres, with only now and then cultivated spots, presenting on the whole a very rugged and wild appearance. This tract is bounded on the N. by Arapahoe Creek and on the S. by Pedlar Creek, inclosing an area of about 3 miles in width by 6 in length, extending from SW. to NE. Over this section the cloud passed harmlessly and without attracting much attention.

Mr. William De Bord, living E. of Parker about 2 miles, saw the cloud (time about 4 p. m.) as it passed by him to the S. It was several hundred feet above the ground, and very small and narrow, resembling an elephant's trunk; no damage was committed. A light storm of rain and hail had preceded its appearance about fifteen minutes; wind from the NW., but as soon as it came in sight the wind changed suddenly to the SW., blowing quite strong. The weather had been very sultry and threatening most of the day, with a southerly wind. The ground was very dry, and vegetation had suffered for want of rain, which had not fallen for several weeks. A short distance to the NE. the funnel approached the ground on the farm of Mr. Jackson Smith, passing about 250 yards S. of his house, but doing no damage to speak of. A few lengths of fence were displaced, and scattering rubbish thrown about over a width of 60 to 80 feet. The first decided manifestation of the tornado's power was on the farm of Mr. Dudley Messick, about 2 miles NE. of Mr. Smith's. Mr. Messick's house is situated upon a slight rise of ground just across Arapahoe Creek, to the N., and 30 rods W. of the storm's center. As the funnel reached the creek it descended for the first time into the heavy timber lining its banks, smashing it up terribly for a width of nearly 300 yards. Elm and hickory were twisted into ropes, while oak and cottonwood were broken off near the stump, or divested of limbs and shattered throughout the trunk. Trees thus destroyed varied in diameter from 6 inches up to 3 feet. As the cloud approached the timber on its southern line, only the tops of the highest trees were destroyed at first, gradually descend-

ing, until they were torn from the ground. It followed along the creek to the eastward for about one-fourth of a mile, when it turned to the NE., passing up a gradual elevation of about 60 feet, to the rolling prairie. The tornado passed the house of Mr. Messick about 4 p. m., he judging of the time somewhat by the fact that his children were just entering the front yard on their return from school, which was regularly dismissed at 3.30 p. m. Half an hour before the storm there was witnessed several miles to the SW. an unusual commotion in the threatening clouds, which were low down in the western horizon, and seemed to be rushing toward a common center from every direction. These clouds looked like smoke and caused Mr. Messick to remark that a heavy wind storm was approaching; in the NW. there was a totally different cloud, to all appearances presenting a dark, heavy, smooth mass, not in commotion, but looking as if it might pour down torrents of rain; lightning was also seen in this cloud, but none in the former. It had been very sultry and threatening all day, with a southerly wind. The storm cloud was first seen coming up over the timber along the creek, but no danger was apprehended until, with the quickness of a flash of lightning (the cloud yet distant about 300 yards) a cow-pen covered with straw, standing SW. of the house, was whirled into the air, scattering the *débris* in every direction. The wind blew from the SW. very strong for about two minutes, bending the trees in the yard to the ground, and causing the house to creak and tremble from garret to cellar. Five trees in the orchard S. of the house were blown down to the NE. East of the house 15 rods, and down in a hollow, stood a hay stack containing about two tons, which was completely turned over to the W., bottom side up, not being blown entirely away, but scattered in a semicircle from right to left. The current of air which did this work also threw down an E. and W. rail fence to the S., and a N. and S. rail fence to the E., S. of the storm's center; but N. of the storm's center the fence was thrown to the W. The current then passed completely around an inclosure of about 50 feet square, containing a large hay and cattle scale, without doing injury to it or the fence about. (Diagram No. 1.) From this point the funnel passed northeastward over the hill before referred to, giving Mr. Messick an excellent opportunity to view its form, who stated

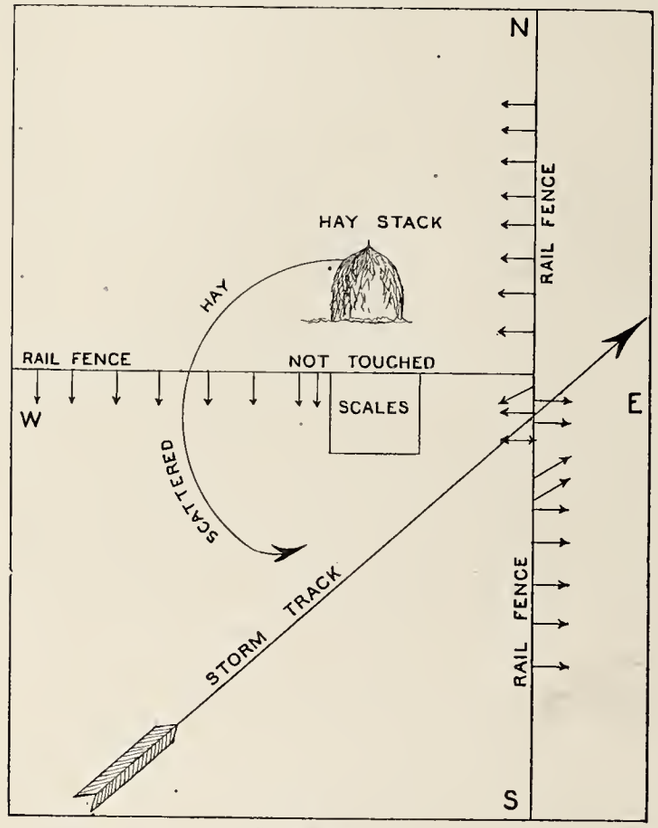


Diagram No. 1.

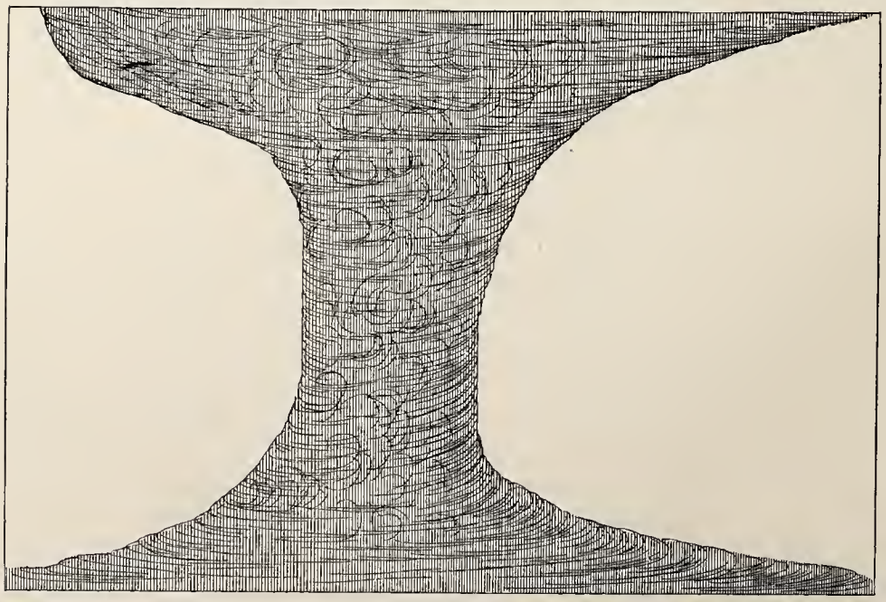


Diagram No. 2.

that it looked to be about 200 feet across near the bottom, and but very little larger at its upper extremity. It had the appearance of dark smoke issuing from a locomotive, and the cylindrical column gyrated continually in a direction contrary to the movement of the hands of a watch. (Diagram No. 2.) Out of the top of the cloud rolled and tumbled in a frightful manner dark masses of smoke, accompanied with a roar that was almost deafening. Mr. Messick saw no lightning in the cloud at any time, and did not distinguish any sulphurous smell in the atmosphere. A few minutes after its passage rain and hail came with a very violent SW. wind, lasting about ten minutes, but not by any means as strong as that accompanying the tornado. The hailstones were scattering, but unusually large, some of them being the size of a man's fist. Then again about dark (three hours later) a very heavy thunder storm set in, without hail, continuing all night, with the wind changing to the NW., and turning quite cool. Mr. J. T. Beason, living on the property of John Harvey, 1 mile N. and 1½ miles W. of the storm's center, experienced no strong wind from the passing tornado, but could see it distinctly in all its angry contortions.

Mr. Chancy Alkive, 2½ miles N. of the storm's center, experienced a gentle wind from the N. during the passage of the tornado. Rain and hail accompanied the wind, the latter exceedingly large, and ceasing to fall in about ten minutes, as the wind changed to the W. Mr. A. J. Sutton, 2 miles SE. of Mr. Messick's, and 1 mile E. of the storm's center, stated that the cloud did not appear to whirl at all, or in fact to develop into a tornado until it reached Mr. Messick's. There was no strong wind at his house, but rain and hail fell just after the storm passed. I very much doubt the reliability of Mr. Sutton's statement regarding the first appearance of the tornado. The cloud, as he viewed it, was high in the air at the distance of several miles to the SW., and most of the time a clear observation was obstructed by belts of intervening timber. It would be rather difficult to discern the whirl of the vortex under these circumstances; however, the peculiar form of the cloud which then existed would determine its character. Mr. Perry Messick, living half a mile E. of Mr. Dudley Messick's, and about the same distance E. of the storm's center, felt no effects from the tornado. He would not have known that it was passing had not his attention been accidentally called to it.

From Dr. Dudley Messick's the tornado passed to the farm of Mr. David Maginnis, three-fourths of a mile to the NE., where it demolished a lumber wagon, carrying the ruins along the track, but not injuring the buildings, which were several rods to the W. of the storm's center. It then passed over the farm of Mr. James Wade, tearing down fences for a width of 250 yards, throwing the rails in N. and S. fences to E., S. of the storm's center, and to the W., N. of the storm's center. The rails in E. and W. fences were thrown to the N. on the E. side of the storm's center, and to the S. on the W. side. At the house of Mr. Lancaster, NE. of Mr. Maginnis's and 200 rods W. of the storm's center (while the doors and windows were open), the dishes on the supper table were blown off, and part of them carried out on the ground. The stock-sheds, 15 rods E. of the house, were blown down and the *débris* scattered for a quarter of a mile to the SE.

Between the houses of Messrs. Maginnis, Wade, and Lancaster, to the W., and Messrs. Wilson, Schmidt, and Richardson, to the E., courses a deep ravine, 40 to 60 rods wide, running from WSW. to ENE. The tornado after passing Messrs. Wade and Maginnis's, crossed the S. portion of the ravine, at a point about half a mile SW. of Mr. Wilson's, where it tore out 20 rods of rail fence in the bottom of the ravine. Here the funnel-shaped cloud, which could be distinctly seen by Mr. Wilson, seemed to halt for about 20 seconds, but whirling constantly with increasing rapidity, as if gathering force for the onslaught to come. As it finally darted forward it passed over the E. bank of the ravine (not following it, though right at its mouth and running in the usual course of the storm), toward the former's house. The building stood just S. of the Nodaway County line, in the NE. corner of the NE. quarter of Clay Township, range 61 N., 36 W., Andrew County, and E. of the storm's center about 100 feet; size 16½ by 32 feet, standing E. and W., and 1½ stories high. The storm struck a few minutes past 4 p. m. Mr. Wilson and family, numbering six, were within the house at the time, where they received the first intimation of the storm's presence by the bursting in of the S. door. Mr. Wilson ran to shut it, hallooing to his son three times in quick succession to close the N. door; but before the latter could even start to fulfill the command, the house was lifted from the earth, turned over on the N. side, and torn to pieces, the storm passing on to Mr. Scmidt's. It was all over in about two seconds. Upon the lifting of the house from the

earth, the lower floor with the family upon it, exeept the father, fell to the ground, while the upper portion passed over it, but not seriously injuring the mother and children. Mr. Wilson, who held to the door with all his strength, eaught hold of the easing as the floor fell, and hung by one arm until he had attained, as he thought, a height of about 16 feet, and a distanee of 50 feet NE. of the foundation, when the building went to pieces and he fell to the ground, eseaping with slight injuries. Almost the entire *débris* was earried to the NE. His son, who started to shut the N. door, was earried to the N. 40 feet, and lodged against a fenee, to which he elung with a tenacity that perhaps saved his life, though he was surrounded and partially eovered with *débris* of all kinds. The barn, 60 feet W. of the house, with the S. door left open, was not injured in the slightest. A eorn-erib, 20 feet S. of the barn, and standing on a foundation of loose stones, was not moved or injured, while the fence eonneeting the barn and crib was earried to the SE. A light board fence S. of the house, the W. end adjoining the erib, had not a board taken off; but the fence N. of the house and running to the W. a distance of 30 rods, and aeross the storm's eenter, was eompletely earried away. East of the storm's eenter, the posts were stripped of their boards and bent over to the N., some broken off, while W. of the eenter they were pulled out of the ground, with the exeeption of a few on the extreme edge of the traek, which were partially broken off or bent over to the S.

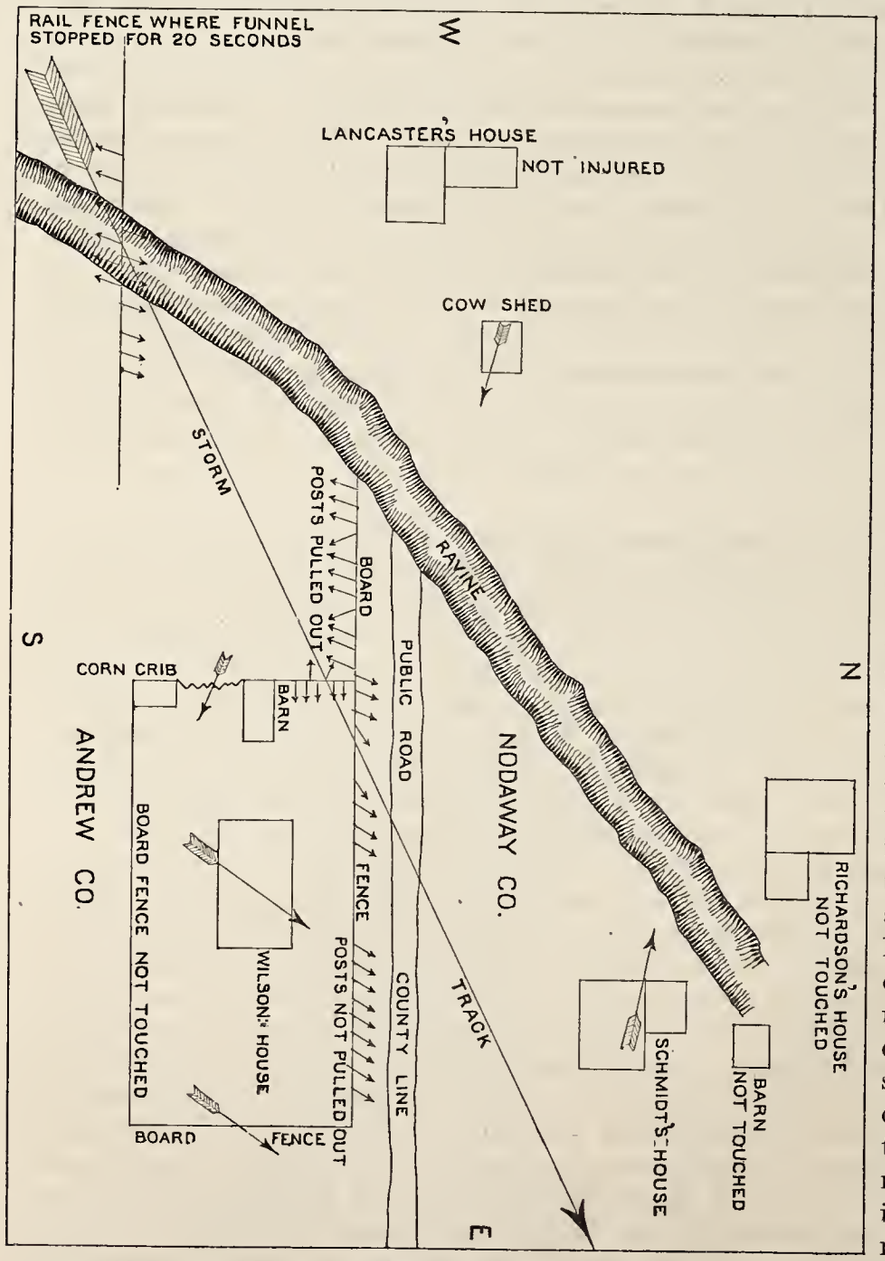


Diagram No. 3.

Mr. Sehmidt's house, whieh stood 60 rods NNE. of Mr. Wilson's, was next visited. The main part was 16 feet square, with a kitchen on the N. side 12 by 16 feet; the E. side was first erushed in, allowing the roof to fall through upon the lower floor, a portion of which struck Mrs. Sehmidt upon the back of her neck, holding her down until released by her lady companion; she was very severely injured. The *débris* of the house was earried to the NW. for from 60 to 80 rods. A small stable, standing 4 rods N. of the house, was not touehed. The house of Mr. Robert Riehardson, half a mile N. of Mr. Wilson's, was not damaged; did not even feel a strong wind while the eloud was passing. The relative positions and eomparative effects of the storm at the houses of Messrs. Laneaster, Wilson, Schmidt, and Riehardson are approximately given in the aecompanying diagram. (Diagram No. 3.) Arrows indieate the direetion in whieh the *débris* was earried. The

house of Mr. John Kimble, 40 rods E. of Mr. Wilson's, and about 70 E. of the storm's center, had chimney blown off, and all loose articles about the building carried away to the NE. The wind was not strong enough to blow down trees. Mr. A. Davis, 100 rods ENE. of Mr. Wilson's, and 60 rods E. of the storm's center, experieneed the wind so strong from the SW. that he could not get from his blacksmith shop to the house, a distance of 7 rods to the S. No particular damage was done to property. From this locality on to the Sixteen-Mile House, a distance of 1 mile, no damage was done except to fences, the cloud passing over the open rolling prairie. The building stood upon a considerable elevation sloping to the S. and E., three-fourths of a mile N. of the Andrew County line and about the same distance W. of White Cloud Creek; size, main part, 16 by 32 feet, one story high, with an L to the N. 16 by 19 feet. The house was occupied by Mr. John W. Phelps and family, and stood 75 feet S. of the storm's center. Mr. Phelps stated that about thirty minutes before the tornado struck the house he noticed a huge dark cloud in the NW., with indications of a violent rain storm, but the cloud bore slowly to the N. without any precipitation. During the day the air had been very sultry, with a SW. wind, and at about 1 p. m. there was a slight fall of rain and hail (latter very small), wind from the S., and lasting for five minutes. This storm was much more severe at Rosendale, about 6 miles S., where dark and heavy clouds were seen in the W. in unusual commotion. The entire family stood out near the house as the tornado came up, which appeared to be traveling about 30 miles per hour, although at times it seemed to spurt forward at a much more rapid pace. It could be seen to the SW., at a distance of about 3 miles, whirling in fearful contortions and throwing out at its top black masses of smoke and every variety of *débris*, while it appeared to be suspended by some mysterious force in a partially clear atmosphere. The width at the lower part appeared to be about 200 yards, and half a mile at the upper, while the attendant roaring fairly made the earth tremble. As it drew near to the house, its way lay through a tall willow hedge, which it whipped into strings for a width of 45 rods, twisting the body of the trees around each other like the strands of a rope. (Diagram No. 4.) It then entered the orchard, blowing down and uprooting 17 trees, carrying their tops to the N. and NE. Crossing the N. and S. road just beyond, it struck the L part of the house first, carrying it to the N.; then in the return of the whirl, a few seconds after, the main part was carried to the E. Both parts were now completely demolished and scattered over some 40 acres of ground. This house was the most completely wrecked of any of the buildings previously visited by the tornado. Stoves, bedsteads, chairs, clothing, in fact every article of household furniture, shared a common fate; nothing was left in a serviceable condition. Two of the house-sills 8 by 10 inches and 16 feet long were carried 100 yards to the NE. A cottonwood tree 2½ feet in diameter, which stood 15 feet N. of the L part, was broken off near the ground and carried to the NW. Eight lengths of fence W. of the house and S. of the storm's center, were carried away to the NE.; while N. of the storm's center 80 yards of fence was carried to the NW. Mr. Phelps and family, upon the approach of the tor

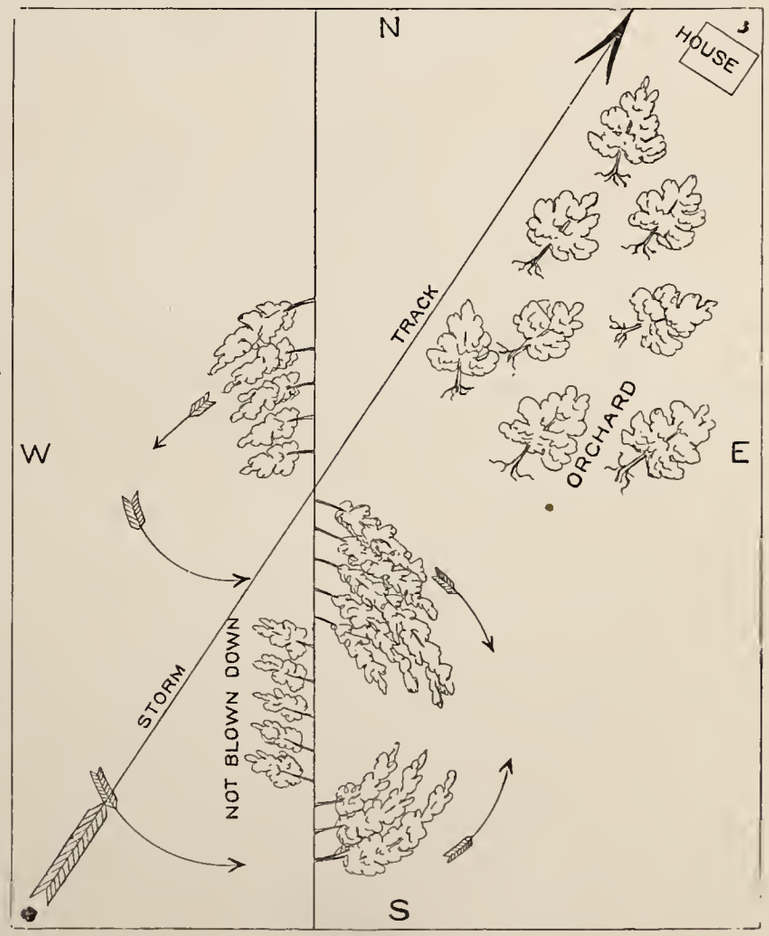


Diagram No. 4.

nado, secreted themselves under a hedge fence, at a point 75 yards S. of the house, where they remained throughout the whole storm without receiving an injury or feeling a strong wind. A loose rail fence 30 feet E. of their position had not a rail removed or shaken. A stable standing NE. of the house 40 feet was unroofed when the L part of the former was destroyed, and its *débris* carried to the NW. The body of the stable was afterwards carried away to the NE. by the return current, that destroyed the main part of the house. (Diagram No. 5.) All parts of the diagram marked with the figure (1) indicate the resulting action of the first whirl of the cloud vortex, and all parts marked with the figure (2) the action of the return current.

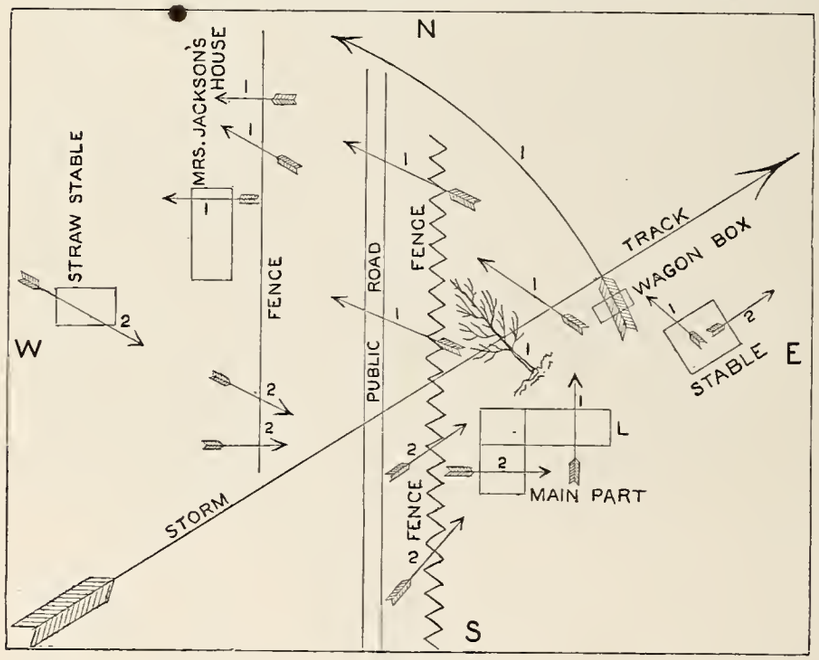


Diagram No. 5.

A wagon-box a few yards NW. of the stable was carried to the NW. one quarter of a mile and partially destroyed. A vest belonging to Mr. Phelps was found 6 miles to the NE. unharmed; also a bonnet, the property of his wife, was found 5 miles in the same direction and condition. The width of the storm's track at this place was found to be about 98 yards. Mrs. Jackson, who lived 20 rods NW. of the Sixteen-Mile House, had about 12 square feet of the NW. corner of the roof of her residence torn off and carried to the W. All of the window sash were blown out by an easterly wind; those on the E. side were found lying within upon the floor, nearly across to the W. side of the house, while those on the W. side were carried out on the ground to the W. The floors were covered several inches deep with dirt, leaves, twigs of trees, splinters, &c. All of the dishes and kitchen utensils were blown out of the house, some of which had never been found. A picket fence running N. and E. of the house was carried away to the NW. and W., while S. of the house a board fence for a distance of 20 rods was carried to the E. and SE. Six cherry trees standing along this fence, and from 6 to 8 inches in diameter, were found twisted around from E. to W. The straw roof of a stable 10 rods W. of the house was carried to the SE.

Mr. Adolphus Mason, living 400 yards SW. of the Sixteen-Mile House, and 80 rods E. of the storm's center (in a considerable hollow), experienced a brisk SW. wind as the tornado passed, and some limbs were torn from the trees in the front yard, but the house was not damaged in the least, although very rickety. Mr. E. M. Litts, living three-fourths of a mile S. of the Sixteen-Mile House, and upon a high elevation, experienced a strong wind from the S. as the tornado passed. Ten rods of N. and S. rail fence, half a mile NW. of the house, was blown to the E., but no damage committed at the house. After leaving the house of Mr. Phelps, the tornado crossed White Cloud Creek, three-quarters of a mile to the E., where it cut a path through the heavy timber 125 yards wide, passing on to the house of Mr. A. J. Turner, $1\frac{1}{4}$ miles beyond, situated upon a rise of ground sloping to the S. and E. This was a new structure and barely finished. The main part was 14 by 32 feet, and one and a half stories high, running N. and S., with a kitchen on the W. side of the N. end 14 feet square and of the same height. The building stood SE. of the storm's center about 80 feet. It was first struck by the wind from the SW., between the kitchen and the main part. The latter was separated from the former, the S. end being moved 33 feet to the NE., and the N. end 12 feet in the same direction. The main part was then lifted in the air and turned bottom side up, falling upon its ridge and breaking to pieces. The kitchen was carried to the N. and completely torn into bits; most of the *débris* in both cases was carried along the storm track to the NE. One sill, 6 by 8 inches and 16 feet long, was carried 75 yards to the SE., and found actu-

ally twisted in two. Apple trees in the orchard NW. of the house were torn up by the roots and carried to the E. and S, while those NE. of the house were blown over to the NE. A high pile of stone, 25 feet W. of the house, was leveled to the ground. A hedge fence 25 rods SW. of the house was whipped to pieces, and the leaves looked as if scalded. A rail fence, 30 feet S. of the house, and running E. and W., was carried to the N. The log house in which the family safely secreted during the storm, and which stood 80 feet S. of the new building, was not damaged save the chimney. An old rail pile, loosely thrown together, 40 feet SW. of the new house, remained intact. The barn and stables, situated 150 yards SE. of the house, were not injured. (Diagram No. 6.) Two miles of fence were completely torn down; N. and S. fences were carried to the E. and NE., and those running E. and W. were carried to the S. In speaking of the atmospheric conditions preceding the storm, Mr. Turner stated that the weather was threatening, with a variable wind during the day. About noon there was a slight sprinkle, with a brisk S. wind. At 2 p. m. another rain came, accompanied with hail, the latter scattering but very large; the wind blew very violently from the S. for a few moments. The weather was so excessively hot during the middle of the day and early afternoon that both Mr. Turner and his wife watched the clouds, being apprehensive of some terrible storm. About 3 p. m. two clouds were seen rising, one in the NW. and the other in the SW., entirely different in form and appearance. The former was the darker, heavier, and broader, having a clear, smooth surface, but intensely dark, and indicating heavy rain, while the latter was of a lighter cast, presenting the appearance of huge columns of smoke belching forth from a monster furnace, and suggesting the approach of a heavy wind storm. These two clouds continually approached each other until columns of smoke appeared to ascend immediately between them.

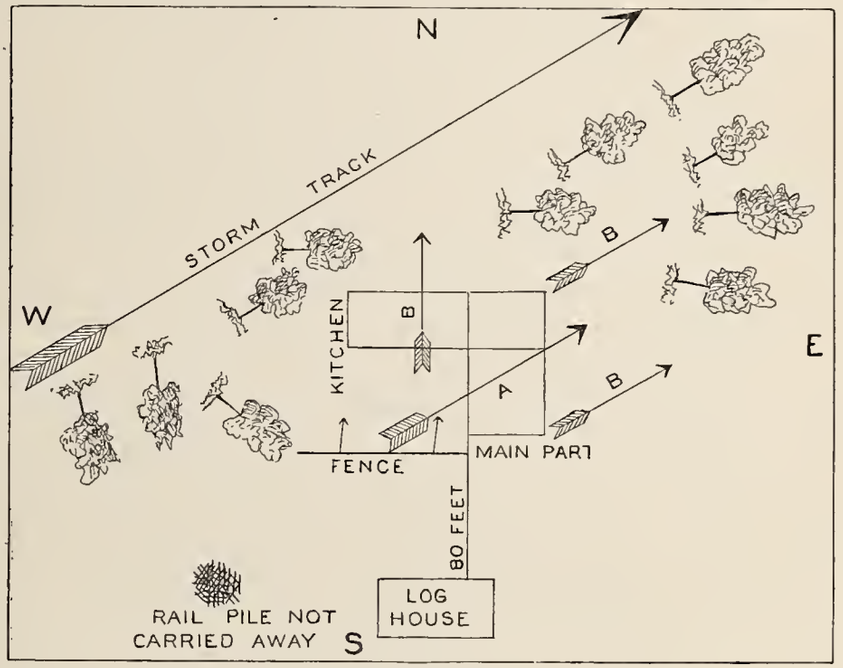


Diagram No. 6.

The wind at this time was strong from the S. and the heat suffocating. In a few minutes the funnel-shaped cloud appeared in the exact place where the column of smoke had before been seen ascending. The wind now changed to the SW., and the roaring was distinctly heard. Of course the funnel was well developed before they saw it, as their horizon was somewhat shortened by intervening hills and the apple orchard to the W. When the column of smoke was seen ascending, it was no doubt the effect of the rolling and whirling motion of the upper part of the funnel, for they judged its distance to be about 5 miles, which, under the circumstances, would necessitate a change of their horizon so as to shut out the lower portion of the funnel. When the cloud was distant about half a mile, all kinds of *débris* could be distinguished flying around in it in the most frightful manner, nearly paralyzing the anxious watchers with terror. It passed the house between 4 and 5 p. m., and as the SW. current struck the latter, the concussion and noise was as if a heavy cannon had been discharged near the building. During the destruction, which was almost momentary, the buildings and everything about them were enveloped in dark, whirling masses of smoke, so thick that it seemed as if they "could have been cut with a knife."

The roar of the storm was deafening and drowned the noise from every other source; not even the crashing and grinding of the timbers of the new house could be heard, or the falling of a large tree against the S. end of the log house, in which, as I have before stated, the family had resorted for safety, and where they were at that moment crouching in anxious expectation of a terrible fate.

Said Mr. Turner, "No pen could possibly portray the awful scene or depict the indescribable terror and complete prostration of our physical powers during the short passage of the storm, but which seemed to us an age." The funnel now crossed the highway, and entered upon the premises of Mr. Henry M. Harman. His buildings stood about 40 rods NE. of Mr. Turner's and just S. of the storm's center. The house was a large frame one, standing 100 yards SE. of the storm's center, and on ground about 20 feet lower than the large barn. Its size was 24 by 26 feet, and one and a half stories high, with an L attached to the S. side, running N. and S. 16 by 30 feet, and of same height. The L part was struck on the W. side, the S. end moving 15 feet to the NE., and the N. end 6 feet, before touching the ground. The W. side and roof was then torn off and carried some 80 feet beyond the house and lodged in the orchard. The main part was not moved or injured, but a large stone chimney on the W. end was cracked. The barn, the largest and strongest in the vicinity, 48 by 63 feet, 16-foot posts, with nearly all of its timbers 8 inches square, stood 30 yards SE. of the storm's center, and 70 NW. of the house. The entire building was moved on its foundation 4 inches to the E. It contained about 15 tons of hay and grain, besides a large number of heavy farming implements. The roof was completely torn off, apparently by piecemeal, and scattered along the storm's path for a distance of 3 or 4 miles. A heavy stone wall, forming the basement and the foundation upon which the barn rested, was cracked half an inch wide from top to bottom on the W. side. A granary, which stood 50 feet N. of the house, was carried due N. and torn in two, the eastern half being scattered along the track to the NE. In a grove of cottonwoods which stood 80 feet NW. of the house, the trees were broken or twisted off from 12 to 20 feet above the ground, and their tops carried to the N. An old barn, standing half way between the house and the large barn, 36 by 32 feet, and 12-foot posts, was entirely taken away down to the floor, and the *débris* carried to the NE. and NW. The principal part of the *débris* of both barns went to the NE., but some portions were found to the NW., W., SW., and SE. A hen-house and tool-shop 60 feet SE. of the old barn was swept clean from the ground and the *débris* carried to the N. A sorghum mill, which was situated 20 rods SSW. of the large barn was entirely destroyed and the *débris* carried to the NE. Mr. Harman's hired man, James Baker, weighing 160 pounds, ran out of the large barn on the E. side, as the storm struck it. After leaving the barn he was caught up by the wind and carried around the building by the N. to the SW., a distance of 125 yards, and landed unhurt but very dizzy.

When Mr. Harman came out of the house as the storm went by, to call the hired man, he noticed with considerable surprise, that Mr. Baker was coming toward him from the direction of Mr. Turner's. Upon questioning him as to his whereabouts and experience, Mr. Baker recollected of coming out of the barn, of being caught up and then set down again, but nothing whatever during the interval. (Diagram No. 7.) Two of Mr. Harman's sons were in a field 50 rods SE. of the barn as the storm approached, coming up hurriedly with a team and lumber wagon. After reaching nearly half way they unhitched the team and turned them loose, secreting themselves as best they could. The horses moved to the N., nearing the path of the storm, and when it passed both were stripped of their harness, which was literally torn to pieces. One of them was instantly killed, and the other bled to death from ugly wounds received from the flying *débris*. A scantling 4 inches square and 10 feet long was found imbedded in the ground a depth of $3\frac{1}{2}$ feet, at a distance of 45 rods NE. of the house. The soil was a black loam and rather easily penetrated after the tough sod had been cut through for 2 inches. A large red board taken from the barn, 16 feet long and 1 foot wide, was found 2 miles to the NE., not broken or split, and the nails still in it. Regarding the time at which the storm passed, Mr. Harman stated that he called his sons from the field at exactly 4 p. m., because of the unusual appearance of the clouds in the W., but the tornado, which appeared to be about 2 miles away, came on so rapidly that the latter could not reach the house, as before stated. After all was quiet following the storm, Mr. Harman found that his clock had stopped at 4.05 p. m. Mr. John J. Swartz, living $1\frac{1}{2}$ miles S. of the storm's center, did not feel any strong wind, but while the tornado was passing it blew gently from the SW. After the storm a very strong westerly wind, accompanied with rain and hail, prevailed for a few moments. Toward sundown the wind changed to the N., accompanied with heavy rain, which lasted nearly all night. Mr. G. K. Montgomery, $1\frac{3}{4}$ miles S. of the storm's center, experi-

enced a gentle wind from the SW. before the tornado passed, quieting down to a calm by the time it was nearly opposite him to the N.

After leaving Mr. Harman's the funnel reached One Hundred and Two River, three-fourths of a mile to the NE., up which it passed for 1½ miles changing its course about 10° to the N. At the edge of the heavy timber lining the banks of the river, and 200 feet E. of the storm's center, stood the house of Mr. J. H. Benson. The earth about the walls, which had been mixed with broken stone and pounded down solid, was blown out so as to form trenches several inches deep along the S. end and W. side. The house was not injured except by the branch of a tree, which was thrown through the W. window. The barn stood W. of the house and nearer the storm's center, but was not entirely destroyed, being moved off the foundation to the NE. a distance of 8 feet. The two doors on the E. side were torn off and carried to the N. 150 feet. The timber N. and W. of the house was terribly broken up for a width of over 250 feet; trees from a few inches to 3 feet in diameter were uprooted, broken off close to the ground, or twisted into splinters. The prostrations on the E. side of the storm's center lay pointing to the N. and E., and on the W. side to the W., NW., and S. In crossing the river, which had very low banks on the W., but little raised above the bed of the stream and coinciding with the general level of the valley for one-fourth of a mile westward, the path of destruction widened out from 200 yards to one fourth of a mile. The width of the forest along the river where the passage was made was from a mile to a mile and a half, the timber consisting of walnut, hickory, oak, elm, sycamore, and cottonwood. Trees from 6 inches to 2 and 3 feet in diameter were broken off like pipe-stems; where they were too tough to break easily they were twisted, always in a direction from right to left, until the trunk was splintered. On the outer edges of the path of destruction only the tops of the trees were broken off, and occasionally instances occurred where only the limbs on the inner half of the tree were taken; that is, the half nearest the storm's center. In many cases limbs 5 or 6 inches in diameter, and smaller were found wound around the bodies of the trees, always in the same direction, from right to left. The W. side of the storm's path was narrower and more regular on its outermost edge than the E. side, which was quite irregular, due to the presence of swathes cut in toward the storm's center from the SW. and SE., varying in width from 30 to 50 feet, and separated by intervals of from 200 feet to 40 rods. The E. side varied from 80 to 180 rods in width, while the W. side was at no place over 70 rods, and often as narrow as 25 rods. (Diagram No. 8.)

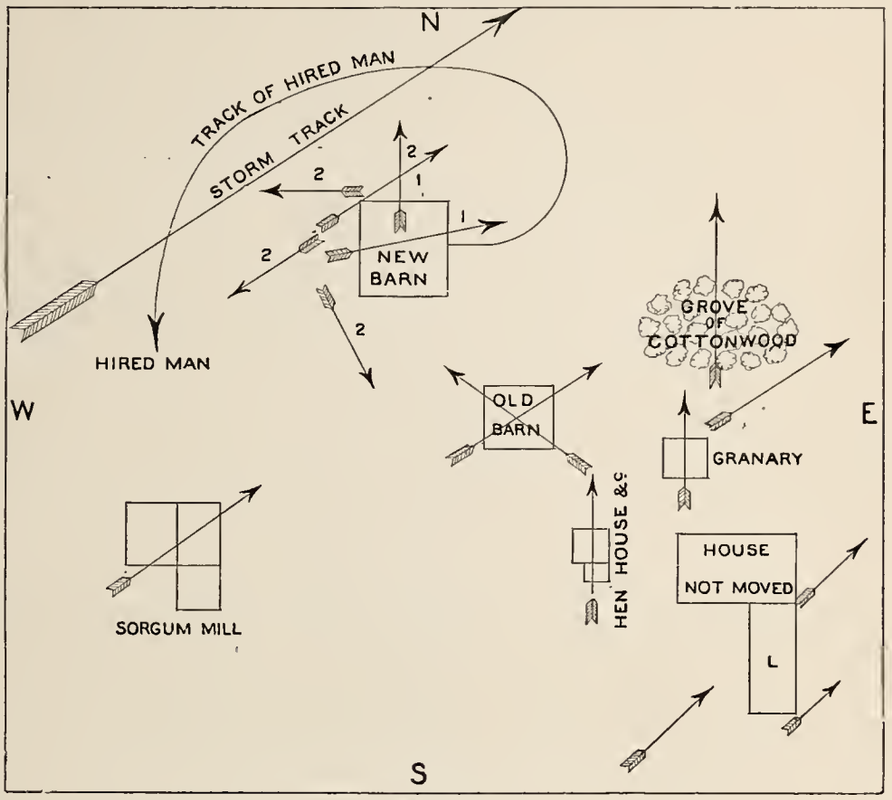


Diagram No. 7.

When the storm cloud reached within 1¼ miles of Barnard to the northward, which is situated on a considerable eminence E. of the river, it turned to the NE. again, passing about 80 yards NW. of the house of Mrs. Sarah Goforth. The house was not much injured, although the wind blew very hard from the SW. The barn, which stood 200 feet S. of the house, had the S. doors blown in, and otherwise considerably damaged. Several trees in the orchard N. of the house were blown to the W. A N. and S. fence crossing the storm's track E. of the house was thrown inward

toward the center. From this point the storm passed through the timber for three-fourths of a mile up a gradual ascent to the NE., and before passing the house of Mr. Francis Conlin, 1½ miles E. of Barnard, it descended into a deep heavily wooded ravine. In passing through this ravine the storm's center approached within 300 yards of Mr. Conlin's house, which was situated on the high ground to the SE. The house was new and hardly yet finished; size, 16 by 30 feet, and one and one-half stories high. The wind first struck it at the SW. corner and moved it from its foundation 15 feet to the E., wrenching it out of plumb about 3 feet; the S. end was thrown to the E. and the N. end to the W. The fact of its being constructed of heavy oak timber, and the cloud some distance to the NW. in the ravine, no doubt saved the house from total destruction. A granary 300 feet NE. of the house, but nearer the storm's center, containing 260 bushels of wheat, was completely torn to pieces, and all but 50 bushels scattered to the winds. Wheat was found the next day scattered along the storm's path for a distance of 2 miles, and over a width of from 30 to 60 feet. A corn-crib standing near by, and containing 800 bushels of corn in the ear, was also demolished. The roof had not been found, and only 200 bushels of the grain were left upon the ground, the rest being carried along with the wheat. Between 200 and 300 chickens were carried away, only 9 of them returning after an expiration of fifteen days. The bodies of dead fowls were found about the fields and along the storm's center for a distance of 2 miles or more, stripped of their feathers and badly mangled. Several were found hanging by their heads in the tops of trees, and others were blown into the hedge fences. A large government-wagon box, covered with about 200 pounds of iron in the way of fastenings, was carried away from near the corn-house, and no portion of it afterwards discovered. Two sulky cultivators, weighing between 400 and 500 pounds each, were broken into pieces and portions carried to the E. for a distance of one-fourth of a mile. An old log house, 24 feet square, and standing 60 feet ENE. of the house, was only unroofed, the *débris* being carried to the NE. A N. and S. hedge fence, E. of the house 40 feet, was completely interwoven on its W. side only, with *débris*. Mr. Bowman's log house, 25 rods SSW. of Mr. Conlin's, and 250 yards E. of the storm's center, had its roof carried off to the NE. An E. and W. hedge fence near the house was filled with *débris* on the S. side only. Before proceeding further with the storm track, I will give the statements of several gentlemen living in or near the town of Barnard concerning their experience and observations upon the passage of the tornado.

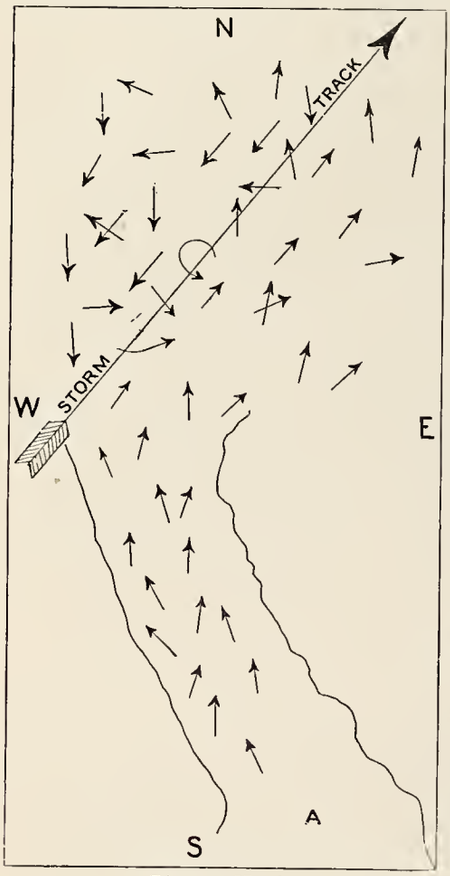


Diagram No. 8.

The opportunities for making quiet and reliable observations upon the atmospheric conditions of the approaching storm were much better where the observer was removed a mile or so from the storm's path than where he was within the immediate influence of the furious monster, as under the latter condition he would be compelled to seek a place of safety for his life and property, and could not thereby observe the storm's effects with accuracy. The town of Barnard was removed from all danger of the storm, being situated upon the divide between One Hundred and Two River and Long Branch Creek, 1¼ miles N., and about the same distance E. of the storm's center. It offered an excellent opportunity for observation, because from its elevation the storm cloud could be watched for miles before and after its passage. Dr. A. W. Bear stated that the 29th was a day of unusual warmth; the air in the forenoon was clear and the wind quite brisk from the S., from which point it had been blowing for several days. About 2 p. m. it began to cloud up in the W.; wind still from the S., and the air growing more close. At 3 p. m. a very dark and heavy cloud was seen looming up from the NW. horizon, looking as if it might bring in a short time torrents of rain, while at the same time a decidedly different cloud was observed rising in the SW., like smoke from a burning building, or, more nearly, some large straw-stack. The latter cloud

rose much more rapidly than the former one, and was continually in commotion. By the time the two clouds had, to all appearances, reached each other (and at the same time moved nearer the city) the column of smoke proved to be a well-developed tornado, having the form of a waterspout at sea. As it drew nearer, all kinds of *débris* were seen to be playing about in the whirl cloud, and a terrible roaring accompanied it. There seemed to be four well-developed motions to the cloud, viz, upward through the center, downward on the sides, a twisting motion contrary to the hands of a watch, and a long wave-like motion from side to side. The latter motion was not as oft-repeated as the others, but at intervals of from two to three minutes. The large cloud in the NW. after the formation of the funnel was left in the rear, causing the rain and hail which it brought, to occur a few minutes later at each point than the time of the passage of the tornado. At the distance of 5 miles the funnel appeared to be 50 feet across at the top, 20 feet at the bottom, and 250 or 300 feet high, not perpendicular, but the lower part thrown forward at an angle of about 45° with the horizontal. Whenever it commenced to destroy objects upon the ground, the lower part spread out, sometimes as wide as the top and even wider, especially when it entered a belt of timber, where it had more of an opportunity to reach out and be drawn from one tree to another, and less chance for its dimensions to be wholly controlled by the opposing currents of air which formed the cloud. There was no rain or hail during the day until the occurrence of that which immediately followed the tornado, and which came with a NW. wind from the cloud previously referred to. It did not rain hard, but the hailstones were unusually large and scattering. About two hours after this precipitation, which lasted ten minutes, a very heavy rain followed, mingled with small hail; wind still from the NW.

Dr. John S. McAdow, who resided at Barnard, but was, upon the day of the storm, 8 miles NE. of the city, and about the same distance NW. of the storm's center, attending a patient, near Platte River, stated that at 2 p. m. the weather was exceedingly sultry; hardly any air stirring. At 3 p. m. dark clouds were seen appearing in the SW. and NW., with the wind southerly at the surface. In about twenty minutes thereafter the wind changed to the NW., coming with a dash that made the house tremble, and so cold as to cause every one to shiver, and endanger the life of his patient. In from two to five minutes rain and hail fell, the latter scattering and of unusual size; some of the hailstones could not be placed in a pint measure. The rain-drops were also very large and scattering. After precipitation ceased, alternate gusts of hot and cold air were felt from the S. and NW., and the whole horizon seemed to be lined with dark, heavy, threatening masses, but breaking away before the funnel appeared. In about twenty minutes after the black cloud had passed, which caused the first rain and hail, the funnel appeared by itself surrounded by almost a clear sky, which caused many to wonder at the unusual scene. Then in a few minutes a second but smaller funnel appeared about a mile in rear of the former, and moving parallel with it, but soon disappeared from view. The large funnel seemed to be bounding along, first rising, then falling; could easily distinguish that it whirled contrary to the sun, and as it drew nearer flying *débris* was apparent in the upper part of the funnel. For about an hour after it passed to the E. there was no prevailing wind, but a constant interchange of hot and cold currents, after which there came up a strong wind from the SW., bringing heavy clouds, attended by rain and hail. The fall of rain was exceedingly heavy, and the hail small but very thick. In half an hour it appeared to be clearing up, and the doctor started home. He had not gone far before he encountered a second storm, attended by the most terrific display of lightning and the heaviest peals of thunder that he had ever heard of or witnessed. The whole heavens were, at times, one sheet of flame, and then again traversed by a labyrinth of darting tongues of fire. Now and then, while urging his horse along at the highest speed, he would pass through a stratum of air so hot that it would nearly burn his face, and then again through a stratum that would make him shiver and draw his coat more closely about him. This storm lasted about three-quarters of an hour.

Dr. James W. Heath, of Barnard, watched the storm from his residence, which stood on about the highest ground in the town, and from which the surrounding country could be viewed for miles. Thursday morning, the day of the storm, opened bright and clear with a southerly wind, but the air close, as if heavily ladened with moisture. Early in the afternoon it began to cloud up in the SW. and NW., with wind from the SW., and very hot. The cloud in the SW. looked like smoke ascending from a burning building, the rising column vibrating from side to side. In

a few minutes this vibrating column, as it drew nearer, proved to be funnel shaped, after the pattern of a waterspout. This was between 3 and 4 p. m., and the wind southerly; a few miles W. of Barnard it was from the N. The tornado passed the town at 4 p. m.; could hear heavy roaring for a distance of 4 miles, and see the funnel rise and fall. As it came down to the ground it would spread out on the surface to a width of several rods, remain quivering and twisting for a moment or two, then rise and contract to a diameter of about 4 feet, not lifting itself directly up, but slowly gliding upward in a wavy motion from right to left, consequent upon the inrushing of warm air from the S. There was no rain or hail before the tornado, but it fell about ten minutes thereafter, with a westerly wind. The hail was very large and scattering, some of them the size of a man's fist. They were also strangely shaped, some oblong, some flat like a saucer, and some nearly round and covered with cone-shaped crystals half an inch long. The doctor stated that a smaller funnel was seen to accompany the larger one in what appeared to be a parallel path but situated about 2 miles to the N. of it and beyond the divide between One Hundred and Two River and White Cloud Creek. It continued in view for only a short distance, when it was lost in the timber. About dark a second storm of rain, and small, thick hail set in, continuing for an hour.

Mr. Jos. H. Blagg, 3½ miles S. E. of Barnard, and 1 mile E. of storm's center, stated that the tornado passed his house a little after 4 p. m. Before it came, he saw clouds in the SW. and NW., but entirely different in appearance; the former were dusty and smoky, and in great commotion, while the latter were smooth, dark, and heavy. The wind at this time was in the SW., and in about ten minutes, as the clouds approached nearer, currents of air were distinguished moving from the NW. and SW. The SW. clouds were the highest and moved the most rapidly. After the funnel formed it was noticed that no objects were drawn into it from the NW., but only from the S. or SW. Preceding and during the passage of the tornado, only southerly winds were experienced, but afterward had a westerly wind with rain and hail. Did not see any lightning in the funnel, or hear any thunder during its passage. There was a severe thunder storm between 2 and 3 p. m., 3 miles NE. of Barnard; team killed by lightning.

Mr. Alfred Ulman, 1 mile W. of the storm's center, and 2½ miles WSW. of Barnard, stated that before the tornado had a hot wind from the SW., changing to S. as the funnel passed, followed in about ten minutes by very large hail and large scattering drops of rain; wind NW. It slacked up soon, and became almost calm, continuing so for half an hour, when there came up a dash of wind from the SW. Mr. Ulman was out in the field plowing, when his attention was drawn to a startling appearance in the SW., unlike any cloud formation he had ever seen, and in direct contrast to the NW. cloud, which looked like all storm clouds previously seen. The former resembled a column of smoke in great commotion, dusty masses tumbling about in the greatest confusion. The cloud above the funnel was light and fleecy, and looked as if the sun was shining throughout it.

Mr. William Barringer, 3½ miles SE. of Barnard, and three-quarters of a mile E. of the storm's center, could easily distinguish that the funnel revolved contrary to the hands of a watch. While the tornado was passing, the wind from the SW. blew sufficiently strong to prostrate trees and fences, all of which were carried to the NE. After the storm, there was rain with a SW. wind, but no hail. Two miles E. of his place, the SW. wind was still strong enough to demolish fences.

Mr. G. W. Campbell, 2 miles S. of Barnard, and half a mile SE. of the storm's center, stated that a strong SW. wind, which prevailed during the tornado, blew down one-fourth of a mile of N. and S. fences to the E. A piece of boxing 8 feet long was found near his house, carried from Mr. Harman's, 2½ miles to the SW.

Mr. George Simons, 2½ miles ESE. of Barnard, and three-quarters of a mile S. of the storm's center, was first attracted to the presence of the storm by shingles, broken pieces of timber, limbs of trees, clothing, and leaves falling down in circles in his yard, there being at the time a gentle wind from the SW. It did not rain or hail during the day, but was very threatening in the W. the entire afternoon, which was followed during the evening by a light shower of rain, with the wind from the S.

Mr. George H. Moore, 3 miles ENE. of Barnard, and half a mile N. of the storm's center, stated that while the tornado was passing he felt a strong wind from the NE. It did not appear to come direct, but moved in a circle, carrying *débris* of all kinds, and dropping it in his yard in

eddying whirls. There was no damage done at this place. Before the tornado the wind was so strong from the SW. that Mr. Moore thought his house would blow over, and therefore directed his family to go into the cellar. Half an hour after the funnel passed, rain and hail fell, with a SW. wind. It is of importance to draw a comparison between the falling of *débris* at this place, half a mile N. and W. of the storm's center, and at the house of George Simons (previously mentioned), three-quarters of a mile S. of the storm's center. At the former place the *débris* fell with a NE. wind, moving in a circle, and at the latter it fell with a SW. wind, in whirls. One place was 3 miles ENE. of Barnard, while the other was 2½ miles ESE., on opposite sides, of the track, and, as the effects prove, were under the influence of the same whirl from right to left, one on the northern and the other on the southern edge of it, making the diameter of the whirl at this point 1¼ miles, and the S. side of the track one-fourth of a mile wider than the N., as shown in the following diagram. (Diagram No. 9.)

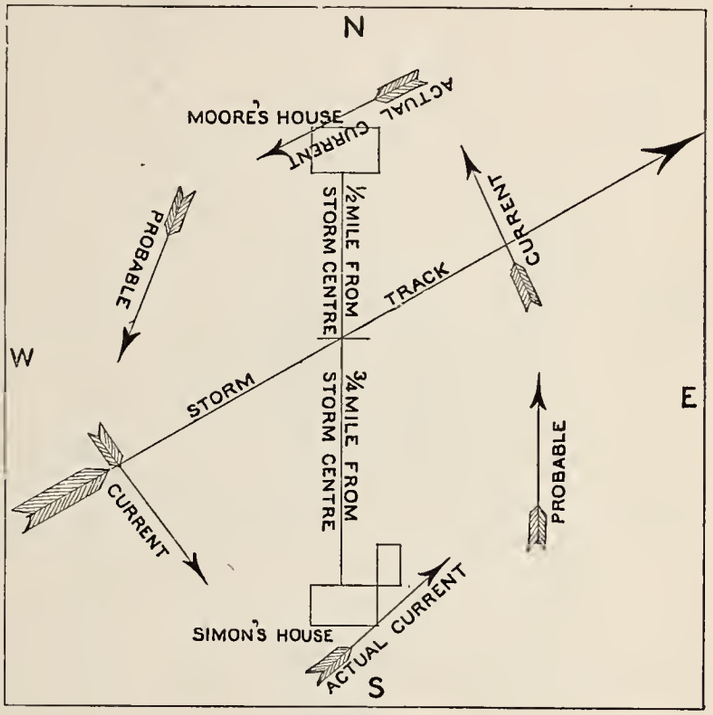


Diagram No. 9.

Mr. Andrew Baker, one-fourth of a mile N. of Barnard, and three-fourths of a mile W. of the storm's center, reported a light wind from the SW. while the tornado was passing; when opposite him to the NE. rain and hail fell.

Mr. W. H. McGuire, three-quarters of a mile NE. of Barnard and half a mile W. of the storm's center, reported that the wind was from the S. before the storm, but while it was passing seemed to blow from every direction. After the tornado the wind changed to the W. About 3 p. m. a black cloud was seen to rise in the SW. and move around to the NW., bringing the first rain and hail, and attended by thunder and lightning. Then a smoky-looking cloud arose in the SW., which proved to be the funnel, but was not accompanied by lightning.

Capt. James A. Forrest, a merchant of Barnard, stated that he saw distinctly a second and smaller funnel accompanying the larger one, and while the latter passed Barnard on the S., the former passed it 4 miles to the N., but did not at any of the time appear to reach the ground. The larger one passed Barnard first, and as it approached the Platte River, 5 miles to the E., it appeared to halt for an instant, many persons feeling certain that it was coming back to the town. While in this position the smaller funnel was seen to deviate from its course and bend toward the larger one, which immediately moved up to meet it, when the smaller funnel instantly disappeared from view, drawing up its tail into the surrounding clouds and mingling its whirl with the larger one.

Mr. Thomas M. Jobe, 3½ miles NE. of Barnard, experienced a strong wind from the SW. while the tornado was passing. There was no damage done. Very large hail fell a few minutes after the funnel passed. Roaring was distinctly heard.

Mr. James Trother, 2 miles N. of Barnard, did not feel the influence of the storm. Heard the roaring and could see the funnel, about 4 miles distant, the *débris* flying about in it. Had rain and hail with a NW. wind after the tornado passed.

Mr. P. G. Briggs, 2½ miles SE. of Barnard and half a mile E. of the storm's center, had six apple trees blown down to the E. and SE., and a quarter of a mile of N. and S. fence carried in the same direction.

Mr. W. H. Elliott, photographer at Barnard, saw from his gallery window the funnel when about 2 miles to the S. It was very regular in shape, and of the form of a balloon, gyrating con-

trary to the hands of a watch and filled with flying *débris*, which seemed to be thrown out only at the top. While the tornado was passing the air was quite still, now and then large hailstones falling to the ground. One near the flour-mill weighed 7 ounces, and several were picked up in the street weighing from 3 to 4 ounces. They were in appearance quite smooth, and flattened at both ends like an apple. After the tornado passed the wind blew very strong from the SE., and in about one hour a very heavy storm of wind, rain, and hail came from the W., which continued far into the night.

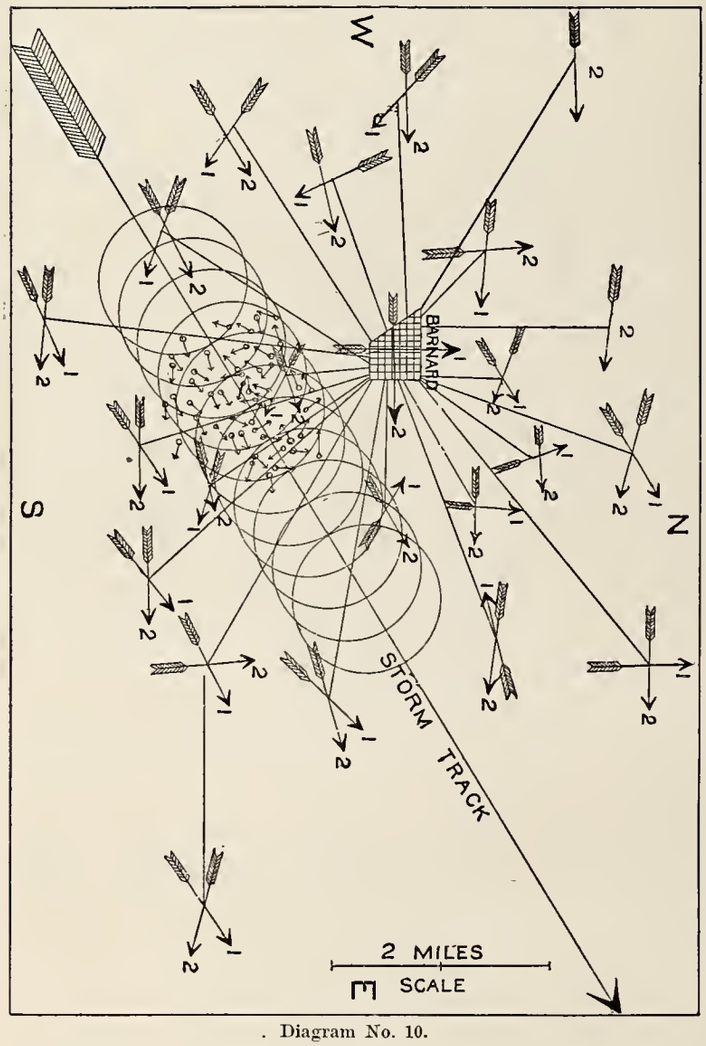


Diagram No. 10.

In connection with giving in writing the positions, observations, and effects of the storm at many places in the vicinity of Barnard, I have prepared a map showing more distinctly than by words the directions of the wind during and after the storm at the several places. The arrows show the direction of the movement of the wind, and the figures indicate the time at which the direction was observed, No. 1 during the storm, and No. 2 after it had passed. The large arrow shows the center of the storm's track, and the circles about it the path of greatest destruction, which represents a section of the latter through the heavy timber lining the banks of One Hundred and Two River, S. and E. of Barnard. The small arrows within the circles indicate the direction in which the trees were thrown. (Diagram No. 10.)

Resuming the description of the course of the funnel from Mr. Conlins, we pass on to the house of Mr. C. C. Robinson, but occupied at the time by Mr. Guilford Richards. The building stood on high ground, above the edge of the timber overlooking Long Branch Creek to the E., and 750 yards S. of the center of the storm. Size, 16 by 26 feet, and one and a half stories high. The storm struck the W. side of the house first, between the hours of 4 and 5 p. m. It lifted it bodily from the foundation, and carried it first 20 feet to the E., then 40 feet to the NE., then again 30 feet farther in the same direction, when it broke to pieces and was scattered along the track through the timber for a distance of about 3 miles. The barn, 100 yards NNE. of the house, had its roof carried to the N. 60 yards, broken to pieces and scattered along the track. The NE. corner of the building was moved 1 foot to the N. A hay roof upon a shed attached to the S. side of the barn was carried off to the E. A corn-crib, made of poles, and standing NW. of the house 50 yards, was half torn down and carried to the E. A N. and S. fence NW. of the house was blown down to the E., and an E. and W. fence NE. of the house was blown down to the N. A sulky cultivator, weighing between 400 and 500 pounds, and standing ESE. of the house 50 yards, was carried one-fourth of a mile to the SE. and broken to pieces. A stove was carried out of the house 40 rods to the E. and destroyed. A lumber-wagon, standing in the shed attached to the barn, was carried 75 yards to the N. with very little injury, while the box upon it was carried 60 rods to the SE. and torn to pieces. Two heavy iron-bound trunks, filled with clothing, were carried one-fourth of a mile E. into the woods, completely torn to pieces, the clothing torn in shreds and scattered among the branches of the trees; some of the garments were carried 2 miles E. to the Platte River. One sill of the house, 10 inches

square and 16 feet long, was carried 40 rods to the E. Several school books were found near the Platte River, 2 miles E. (Diagram No. 11.) A bed was found slightly injured a half mile to the E., and a dog was carried 1 mile in the same direction without apparent injury. Mr. Richards stated that he saw the cloud when about 1 mile distant to the E., its top being filled with flying *débris*, but near the bottom it was so intensely black that he could not distinguish any objects within. The cloud had the appearance of an elephant's trunk, looked to be about 100 yards wide at the top and 30 yards at the bottom. Could easily discern that it was whirling, and that the movement was against the sun. There was no lightning in the funnel, but the roaring was terrible, almost shaking the earth. Some rain and hail fell as the tornado passed, but the largest quantity fell some minutes later. The wind was blowing toward the funnel as it came up and for a few minutes thereafter, when it changed to the NW., with rain and hail, cooling the atmosphere considerably. The width of the path of greatest destruction was 125 yards, but damage was committed upon trees and fences one-fourth of a mile to the S. of the storm's center, and about 40 rods N.

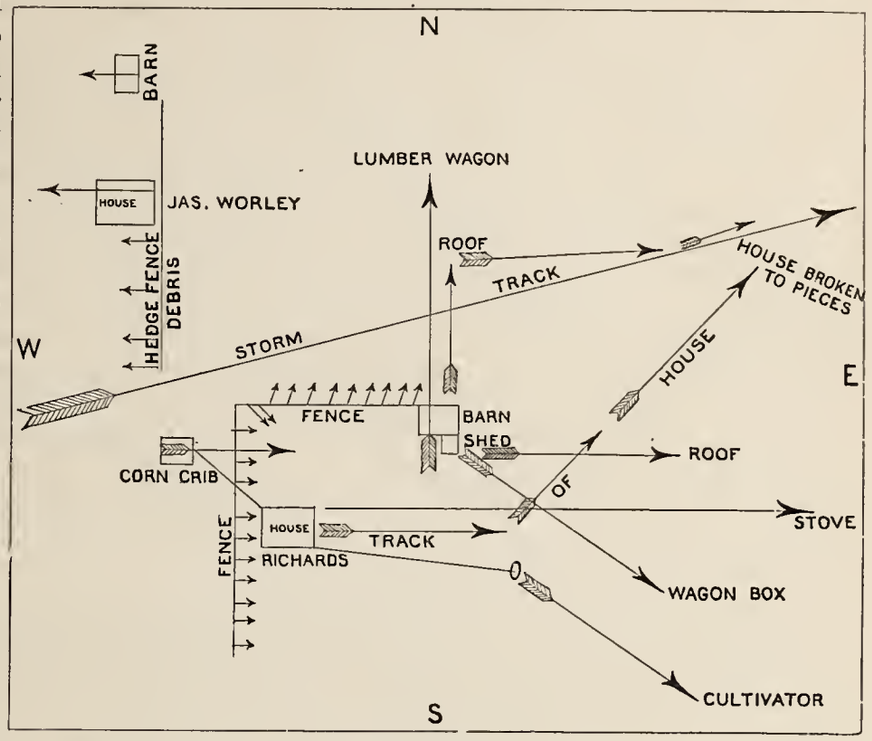


Diagram No. 11.

Mr. James Worley, 250 yards NW. of Mr. Richard's and 75 yards N. of the storm's center, occupied a house 16 feet square, with an L on the N. end 8 by 10 feet. The latter was moved 2 inches to the W. A hedge running N. and S. along the road and to the S. of the house was filled with *débris* on its W. side only. A corn-crib and hay-roof barn, 60 feet N. of the house, were partly blown down to the W., but only the hay was carried away. Several oak trees SE. of the house had some of the limbs twisted about their trunks in a circle from the E. by N. to the W.

At Mr. J. W. Thompson's, 1 mile E. of Mr. Richards's and S. of the storm's center, a smoke-house and a few fruit trees were blown down to the E. This occurred while the funnel was nearly 100 feet above the ground.

Mr. Sanford Rhodes, one-fourth of a mile NE. of Mr. Richards's and W. of the storm's center, whose house stood considerably below the latter's, in the heavy timber of Long Branch Creek and three-fourths of a mile W. of the creek, had the roof taken off from the kitchen which was attached to the W. end of the house, and the *débris* carried to the NE. All of the fencing about the house was carried in the same direction.

Mr. Richards's house was the last one destroyed by the tornado, it lifting from the ground immediately thereafter, sweeping through the tops of the dense timber lining the wide ravine of Long Branch Creek. The funnel cloud passed S. of Mr. Rhodes's house about 20 rods, and tore down the timber for a width of 110 yards in the worst of its path, but some trees were prostrated over a width of one-fourth of a mile. It was plainly evident, from the manner of the destruction, that the funnel did not reach the surface while in the timber, for the trees were generally broken off or twisted at a height of from 10 to 30 feet above the ground. Many had only their tops whipped off, or limbs twisted about their body. A few were pulled up by the roots. This destruction was only continued for about half a mile, when the funnel rose entirely above the timber in the deepest part of the ravine (150 feet below Mr. Richards's in a gradual descent), passing over

the houses of Messrs. Kinsey and Mercer without doing the least damage, and over a succession of densely wooded ravines to the Platte River, a distance of 1¾ miles.

Mr. David Freeman, half a mile E. of the Platte River, stated that the funnel passed above the ground to the S. of him, doing no damage except prostrating a few trees in his orchard. The wind was strong from the SW.

Mr. James Groves, 2½ miles E. of the Platte River and 2 miles NE. of Guilford, on the high prairie, stated that the tornado passed over his house with a terrible roaring, rushing noise, but it was so high that it did no damage, although the wind blew very strong from the SW. in the wake of the cloud. Could distinguish *débris* flying about in it, but the cloud had not a well-defined funnel form, as it appeared to be losing its identity in the dark masses of overhanging clouds. Mr. Groves's position upon the high prairie was such that he could see a distance of 10 miles, and after the tornado had passed him he watched it until it was lost from view, during which time it did not descend to the ground or make any dips downward, nor had he heard of its doing so beyond that point. The funnel after leaving Mr. Conlins turned due E. to Mr. Richards's, where after lifting from the ground it gradually resumed its NE. course, passing 1½ miles NW. of Guilford.

Mr. W. H. Stevens, of Guilford, stated that the storm passed his place about 5 p. m. Could see that the cloud was funnel shaped, and heard the roaring distinctly. During its passage there was a strong wind from the SW. which blew down some fences and the tops from several trees, but did not endanger the buildings. After the funnel had passed five minutes, rain and hail fell with a westerly wind, lasting for twenty minutes. The precipitation was not heavy, but the hail was unusually large, and like rough chunks of ice.

Mr. H. Craig, 1½ miles N. of Guilford, stated that the funnel passed along above the ground, a short distance N. of him. Twenty small shade and fruit trees near the house were blown down by a strong SW. wind, but no damage was done to the house. One mile of fence was prostrated; that which ran N. and S. was carried to the E., while that running E. and W. was blown to the N. The heaviest wind lasted about fifteen minutes. The storm cloud did not seem to be moving very rapidly, nor was its funnel shape very well defined, but the roaring was exceedingly heavy.

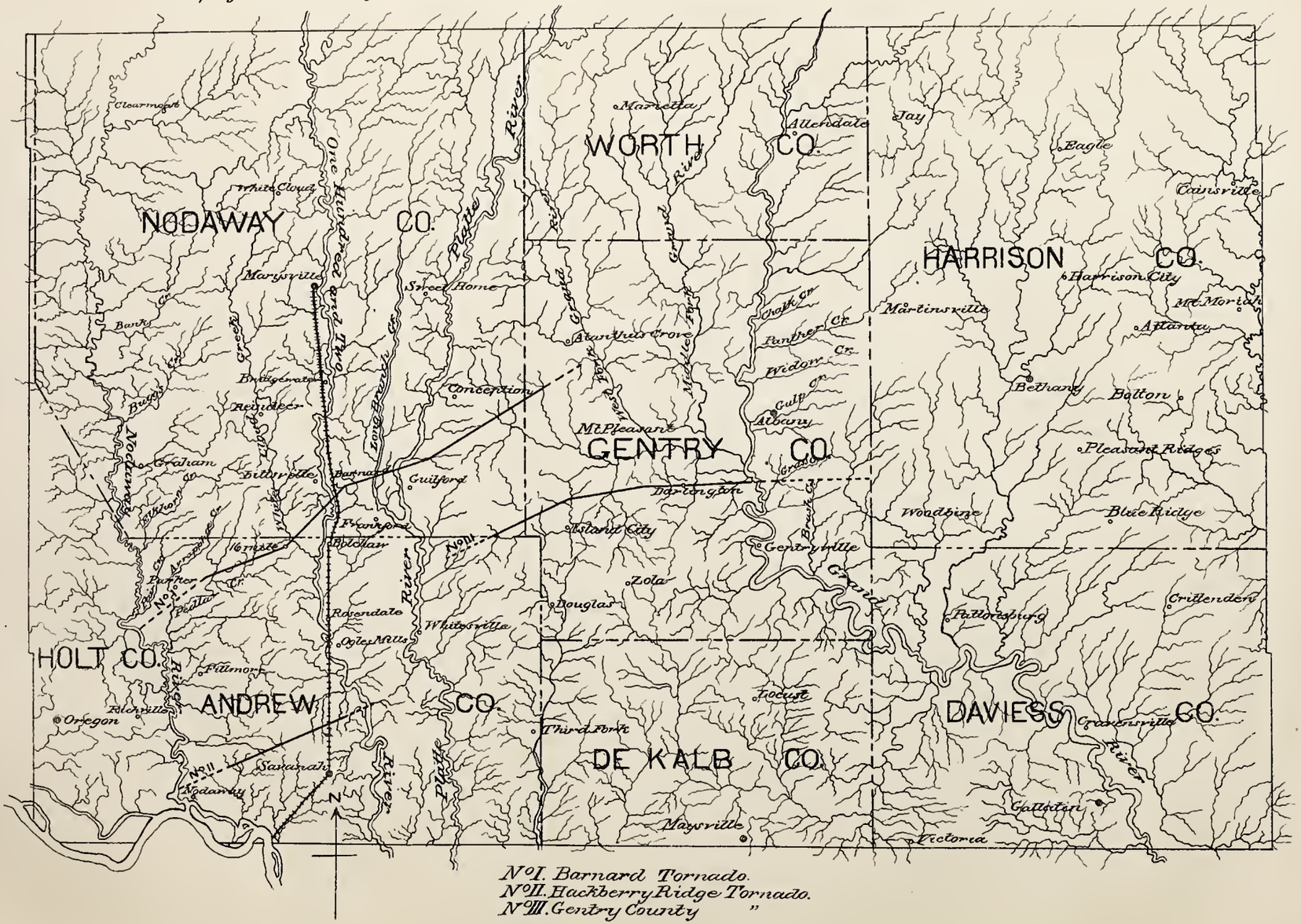
Mr. James O'Donnell, 2 miles SW. of Conception, 3½ miles NNE. of Guilford, and 1¼ miles N. of the course of the tornado, stated that a rain and hail storm, with a strong N. wind, prevailed at his house about 5 p. m., the rain continuing at intervals for one and a half hours. The hail was unusually large and broke all of the windows on the N. exposure. Did not see any funnel-shaped cloud, or hear of any destruction in his vicinity, but at Conception there was a heavy storm of rain and hail from the N., soon after 5 p. m.

This completes the investigation of the Barnard tornado, which lost its identity as such after passing Mr. James Groves's, situated half way between Guilford and Conception, who watched it, as before stated, for a distance of 10 miles to the E. of him. It gradually disappeared in the clouds, losing its funnel form, but the rain and hail, with which it first made its appearance, still continued, which fact would carry the storm about 5 miles into the northwestern corner of Gentry County and possibly into the southern portion of Worth County.

The distance traversed by the tornado from the Nodaway River, between Andrew and Holt counties, to the northwestern corner of Gentry County, including some irregularities in its course, was about 36 miles. The time occupied in making this distance could not easily be determined, as many persons in the course of the storm had no clocks, and those who had considered the time of no importance, or were so frightened that they were at their wits' end to provide means of safety for life and property. Throughout the whole track of the storm, as far as obtaining information was concerned, the people knew the least of anything with reference to the important element of time. However, placing the time of the funnel's starting at Nodaway River at 3.30 p. m. (which by reference to the reports in that vicinity it will be seen can be considered a safe jugdment), and the time of reaching the Gentry County line at 5.10 p. m., the velocity of progression would be 1 mile in 2.8 minutes, or about 21 miles per hour. The course of the storm from the Nodaway River to the northern boundary of Andrew County was due NE.; here it turned to the E. for about 1 mile, resuming again its northeastern course until it reached One Hundred and Two River, when it turned to the NNE. for three-fourths of a mile, then E. again 1 mile to near Long Branch Creek, continuing thereafter without deviation to the NE. throughout the remainder of its course.

Exhibit A.

Map of the Track of the Barnard, Hackberry Ridge and Gentry County Tornadoes, Mo.



No I. Barnard Tornado.
No II. Hackberry Ridge Tornado.
No III. Gentry County "

GENTRY COUNTY TORNADO.

This storm, which proved to be very destructive for a short distance, did not come under my notice until I had completed every preparation, even to purchasing a ticket, to leave the northern counties of Missouri. Although I had made diligent inquiry during my stay at Barnard and vicinity respecting the occurrence of storms in the neighboring counties, no intimation of this disturbance came to hand. I had received considerable information while investigating the "Barnard tornado" concerning a severe storm of wind, rain, and hail during the 30th, between 9 and 10 p. m., which passed through portions of Nodaway and Andrew counties from the NW., causing a large destruction of property. All people spoke of it as a straight wind, and did not mention or leave room for inference that it had developed into a tornado in Gentry County to the E. My first definite information was received from Mr. E. V. Leonard, of Island City, Gentry County, who drove into Barnard just as I was leaving. Hearing of his arrival, and hoping that he might give me some valuable facts from that section, I hastened to confer with him, and found, to my surprise, that a so-called tornado had commenced its ravages near the headwaters of Island Creek, about 4 miles W. of Island City. Taking this fact in connection with the many reports of a heavy storm of wind and rain between Island City and Barnard that I had received, the development of the tornado seemed much more clearly defined, and I therefore made preparations to obtain the best information available.

Mr. W. H. Elliah, of Barnard, stated that on the eve of the 30th, between 9 and 10 o'clock, the town was visited by a very hard rain and some hail from the NW. Wind was very strong, but did no damage within city limits.

Dr. Joseph Heath, of Barnard, stated that, on May 30, the day of the Kansas storms, it was very hot but clear during the forenoon, with a southerly wind. After dinner it began clouding up in the W., and about 9.30 p. m. an exceedingly heavy wind and rain storm came from the NW., continuing all night, washing away bridges, flooding fields, and doing great damage to property. The wind blew violently from the NW. for about twenty minutes, during which time much of the destruction occurred. The hail was large in size and quantity, and struck like rocks against the houses, breaking all the windows on the N. and W. exposures.

Mr. H. Craig, 1½ miles N. of Guilford and 7½ NE. of Island City, reported occasional showers nearly all day, but no heavy wind or rain.

Mr. John H. Moore, 3 miles ENE. of Barnard and 11 miles NW. of Island City, experienced a heavy rain and hail storm between 8 and 9 p. m. from the WNW., continuing for about one hour. Considerable timber was blown down and much damage done to fences. The hail was in larger quantities than on the 29th, but much smaller.

Mr. Thomas M. Jobe, 3½ miles NE. of Barnard, experienced a very heavy storm of wind and rain about 9 p. m. from the NW. It blew down some fencing but three-fourths of a mile to the SE., on Long Branch Creek; the timber was fearfully demolished.

Mr. James Protten, 2 miles N. of Barnard, stated that about 9 p. m. there fell the heaviest rain for many years, considerable hail, but small. The wind blew exceedingly strong, first from the W. and then from the NW. Storm continued for five hours. Five trees in the SE. corner of his orchard were torn up by the roots and carried for several rods to the SE.

Rev. Samuel Huffman, of Savannah, Andrew County, stated that it rained during the morning, but cleared off in the afternoon and remained pleasant. No storm in the evening, but warm southerly winds.

Mr. William Kaucher, at Oregon, Holt County, reported strong southerly winds during the forenoon, with light rains at 10 a. m., and a very heavy thunder storm, wind changing to W. from 7.30 to 9.30 p. m. Hail commenced at 8 p. m. and ended at 8.20 p. m.; precipitation during last storm, 1.51 inches.

Mr. Joseph O'Donnell, 3 miles W. of Conception, in Nodaway County, experienced a heavy rain storm from the NW., but no hail; wind very strong, but no damage done.

These reports furnish indubitable evidence that preceding the tornado formation, and for a distance westward to the Missouri River, there prevailed an unusual storm of wind, rain, and hail. In the neighborhood of the towns of Guilford, Barnard, Maryville, and Mahan, N. of Andrew

County, it came from the NW. and was the heaviest, while at the towns of Forest City, Oreg., and Fillimon to the southward, the storm was not so heavy and came more from the WSW. and SW. At Savannah and Saint Jo, still farther S., no rain fell at the hours previously mentioned, but the weather was fair and warm; southerly winds prevailed. At Saint Jo, a very heavy storm of rain and hail from the W. occurred during the middle of the day, but it cleared away before evening, wind changing to the S. With these peculiar and characteristic conditions N. and S. and just westward of Island City, we may safely connect the subsequent development of the tornado in question, which first appeared near the source of the western branch of Island Creek, and passed ENE., crossing the northern branch 2½ miles N. of Island City, demolishing the small house of a herder on the open prairie and uprooting several apple trees on the farm of Elliott Rose, half a mile farther E. No lightning attended the cloud here, or was reported as seen at any other point in its course. Rain and hail fell a few minutes after it passed. From this locality the storm left no evidence of its course upon the high open prairie for a distance of 2 miles, when it encountered heavy timber upon the numerous southern branches of Wild Cat Creek, and commenced, for the first time, to display its terrific power. The largest trees were twisted off near the ground, uprooted, or broken off, and lay with their tops pointing in a circular direction from right to left within the central path of greatest destruction. Those on the S. side of the center were pointing to the E. and NE., and even NW. when very near the center. On the N. side they were pointing NW., W., SW., and SE.

Mr. Pravers, correspondent of the Kansas City Journal, who was ordered to report upon the storm to that paper, and Mr. Leonard, of Island City, both positively assured me that the cloud in all instances whirled from right to left, that it was funnel shaped, and in every respect a complete tornado. The latter stated that the roaring could be heard for several miles, and sounded like an approaching train of cars. The noise seemed to greatly increase in intensity upon entering the timber, and somewhat diminish when reaching the open prairie. In this portion of the county there was presented a constant alternation of open prairie and heavy timber, which conditions continued for a distance of 5½ miles, until the town of Darlington, consisting of three houses and one blacksmith shop, was reached, distant 5 miles SW. of Albany, the county seat of Gentry County. All of the buildings were demolished except one, the small land office of Captain Pomeroy. The tornado continued to encounter high prairie and timber for a distance of 4 miles farther eastward when it struck the house of Lewis Campbell, on the western side of Grand River, and N. of the storm's center, lifting it from its foundation and carrying it 20 feet to the SE. In crossing the river at Greenwell Ford, 4 miles S. of Albany and 4½ miles E. of Darlington, it lifted the new iron bridge, of 160 feet span and weighing 120 tons, from the stone pier upon which it rested, carrying it into the bed of the river without overturning. The structure was strongly bolted to the abutment at one end, while the other end rested on rollers at the opposite abutment to allow for the expansion and contraction of the iron stringers. The bridge had just been completed at a cost of $4,200, and was still in possession of the contractor, waiting for a small portion to be painted. It was damaged to the extent of about $1,500. As the tornado struck, its oak timbers, 14 inches square, were broken asunder, the whole structure lifted bodily and deposited as above stated. The tornado now crossed the heads of Grass and Brush Creeks, meeting with but a few small out-buildings, some hay-stacks, and fences, disappearing from the high rolling prairie towards the SE. corner of Harrison County, having traveled a distance of about 22 miles. The course of the tornado was due NE. until it reached the N. branch of Island Creek, when it became ENE. for a distance of 6 miles, turning directly E. at Darlington, and continuing in that direction until it reached Grand River, after which it resumed the ENE. course again.

I could obtain no data from which to ascertain the velocity of progression. The storm began, as reported from the vicinity of Barnard and Guilford, about 9 p. m., and some time before 10 p. m., or what was called the early evening, it had reached Darlington, a distance of 21 miles. In all probability it traveled about 20 miles per hour. In its path it traversed alternately hills and valleys, doing similar damage in both, and maintaining a perfect disregard of topography in order to preserve its characteristic course. That its course was more easterly than many of its companions was due, not to the peculiar features of the surface over which it traveled, but to the fact that the formation of the tornado cloud was preceded by a very heavy NW. wind, which, on meeting

the southerly current, overcame to an unusual degree its northerly tendency, causing the tornado to pursue a course the resultant of the two forces. Not one of the other tornadoes came up with as great a contrast between the force of the movements of the warm and cold currents, or, in other words, the NW. and SW. clouds.

HACKBERRY RIDGE TORNADO.

This storm traversed a region of country known as Hackberry Ridge, taking its name from a species of North American tree of considerable height and great beauty, also called sugar berry, nettle tree, and hoop ash. The Ridge covers a tract some 7 miles in width and 12 miles in length, forming a succession of small depressions and elevations in the central portion of Andrew County, between the Nodaway and Missouri rivers on the E. and S., and One Hundred and Two River, on the W. It rises considerably above the general level of the immediate surroundings, and is therefore called a ridge, yet it is not considered by the inhabitants thereabout as a "divide," which latter rises more abruptly and is generally free from timber, its surface forming a high prairie. The tornado appeared as a well developed funnel-shaped cloud on the afternoon of May 29, coexistent with and pursuing a path parallel to the Barnard tornado, but about 12 miles farther S. It very probably originated from the severe thunder and hail storm that prevailed to the S. of Oregon, Holt County, on that afternoon, as reported by Mr. Kaucher, voluntary observer Signal Service U. S. A., who also reported a second hail storm to the N. of the same place, but not covering so wide a track and occurring little later in the day. This reference to its origin is rendered even more probable from the fact that the region over which the hail storm began its depredations lies directly W. of the commencement of the tornado path. The funnel clouds crossed the Kansas City, Saint Jo and Council Bluffs Railroad between Savannah to the S. and Rosendale to the N., 2 miles N. of the former and 6 miles S. of the latter. The timber on both sides of the track was considerably damaged, although it was evident from the tree tops, which were only broken off or twisted about the body of the trees, that the funnel did not reach the ground. A large branch from one of the trees was carried upon the track, delaying for some time the 4 p. m. southern-bound mail train.

Mr. C. S. Pickett, 3 miles E. of Savannah and about the same distance S. of the track, stated that during the day up to 3.30 p. m. it was very sultry, with a southerly wind. At 4 p. m. the wind changed to W. and then NW., and black clouds arose in the SW., and NW., whereupon it began to rain and hail with a NW. wind; the stones were unusually large and scattering. After continuing for about ten minutes the wind changed to SW. and the tornado appeared, moving at a considerable height above the ground. The roaring could be plainly heard, sounding like an approaching train of cars. The cloud was intensely black and resembled an elephant's trunk, but greatly magnified. Considerable timber was blown down N. of Mr. Pickett's, the path of greatest destruction being 150 yards in width; no buildings were injured.

Rev. Samuel Huffman, Methodist minister, at Savannah, stated that at about 4 p. m. it rained and hailed with a NW. wind on the afternoon of the 29th, lasting about fifteen minutes. Heavy and unusually threatening clouds were observed in the NW. and SW. just before the rain, after which the wind changed to SW., when a terrible roaring was heard in that direction. Did not go out to see the tornado. The wind continued high from the SW. for about 25 minutes. It was excessively warm during the day with a southerly wind, which conditions, amounting almost to a drought, had continued for several weeks. Farmers in every direction were complaining that their crops were dying for want of rain, and that the ground was so dry that it could not be cultivated.

Mr. Dudley Messick, over whose farm the Barnard tornado passed, also saw this funnel cloud to the S. of his place about 10 miles, as he judged, he at the time saying that it must be passing along Hackberry Ridge, which statement he afterwards corroborated by a personal examination of the track. There were no buildings injured, the storm pursuing a path entirely confined to the timber, which it did not destroy as savagely as did its companion to the N. Mr. Messick saw the one on Hackberry Ridge first, and had been watching it for several minutes when the Barnard storm came into view. Heard the roaring of each storm distinctly, but considered the one to the S. of him the smaller and less severe, which it proved to be.

Mr. Jackson Smith, who lives 2 miles SW. of Mr. Messick's, also witnessed a funnel-shaped

cloud passing to the S. of him in the direction of Hackberry Ridge. It seemed to be above the ground most of the time, did no damage except in the timber, and remained in sight but a short time, when it disappeared in the overhanging clouds.

Dr. Heath and Captain Forrest, of Barnard, also witnessed this funnel cloud in connection with the Barnard tornado, both of which moved in paths parallel to each other, and with the same apparent velocity of progression; but the latter was considerably the larger, and manifested more power, even when judging of its force at a distance of 5 miles. The course of the Hackberry Ridge tornado was from SW. to NE., extending a distance of over 10 miles. It commenced its destruction in the timber and on high ground, ending under similar conditions. I could not ascertain the velocity of progression, as reliable time, or, in fact, any time, could not be obtained, very few people taking any notice of it, the funnel cloud being much smaller and less destructive than its companion.

THE TORNADO TRACKS.

It may be well, for the purpose of avoiding any misapprehension or doubt concerning the identity of the several tornadoes, to state briefly, in connection with the data presented on the several topographical maps, their relative positions and times of appearance and disappearance.

Commencing in the extreme western portion of the region traversed by these storms, we find the first manifestations of the "Lincoln County tornado" as given at 2.30 p. m. of May 30, ending at 3.30 p. m. At no point in its course was it less than from 12 to 14 miles from its nearest companion.

"Buffalo Creek tornado": Track, 30 miles N. of the "Lincoln County tornado" and 18 miles NW. of the terminus of the "Delphos tornado"; commenced about 3 p. m., ended about 3.30 p. m.

"Delphos tornado": Track, 12 to 18 miles E. of the "Lincoln County tornado"; began at 3 p. m., ended at 4.25 p. m.

"Pipe Creek tornado": Track, 8 to 10 miles E. of the "Delphos tornado"; began at 4 p. m., ended at 4.30 p. m.

"Wakefield tornado": Track, 36 miles E. of the "Delphos tornado"; 12 miles S. of the "Irving tornado," and 15 miles NW. of the "Stockdale tornado"; time of beginning and ending, between 5 and 6 p. m.

"Stockdale tornado": Track, 14 miles SE. of the "Irving tornado"; time of beginning and ending, between 6 and 7 p. m.

"Waterville tornado": Track, 12 miles NW. of the "Irving tornado"; time of beginning and ending, 6 to 6.30 p. m.

"Irving tornado"; Began at 4.15 p. m., ended at 7.10 p. m.

"Clarinda tornado": Track, 40 miles E. of the terminus of the "Irving tornado," and about 30 miles N. of the "Barnard tornado"; time of beginning and ending between 2 and 2.30 p. m.

"Gentry County tornado": Commencement of track 12 miles SE. of the "Barnard tornado" and 14 miles NNE. of the terminus of the "Hackberry Ridge tornado"; time of beginning and ending between 9 and 10 p. m.

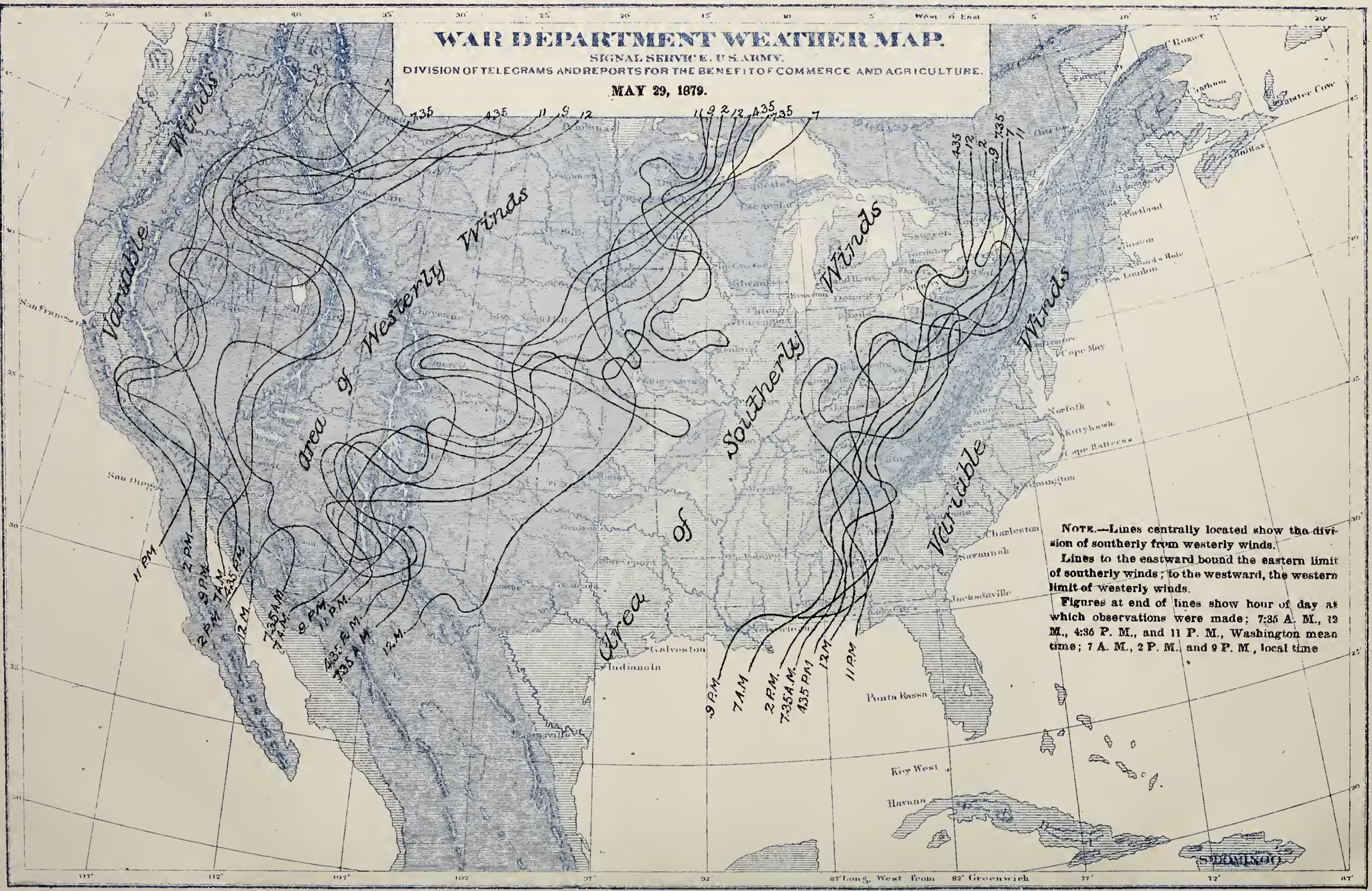
"Lee's Summit tornado": Terminus of track 50 miles SSE. of the "Gentry County tornado"; began at 5.30 p. m., ended at 7.30 p. m.

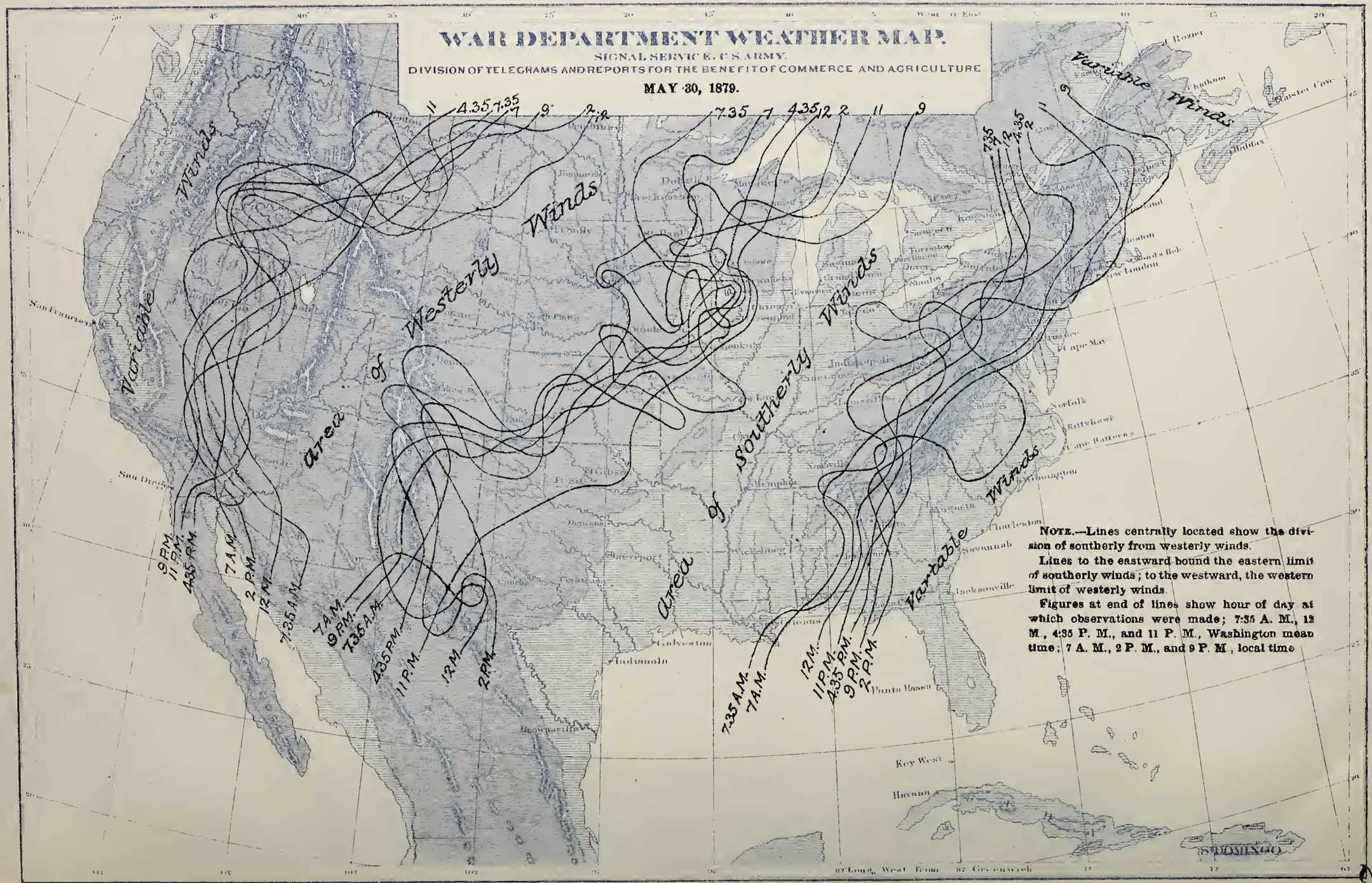
May 29.

"Barnard tornado": Track, 12 miles N. of the "Hackberry Ridge tornado"; began at 3.30 p. m., ended at 5.10 p. m.

"Hackberry Ridge tornado": Track, 12 miles S. of the "Barnard tornado"; time of beginning and ending between 3 and 4 p. m.

Considering these facts in connection with others which appear throughout all of the storm descriptions previously given, limiting the tornado's influence from one-half to three miles outside the immediate path of the central cloud, it will not be difficult to comprehend the individuality of each tornado.


WAR DEPARTMENT WEATHER MAP.
SIGNAL SERVICE, U.S. ARMY.
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.
MAY 29, 1879.
Variable Winds
Area of Westerly Winds
Area of Southerly Winds
Variable Winds
Variable Winds
NOTE.—Lines centrally located show the division of southerly from westerly winds.
Lines to the eastward bound the eastern limit of southerly winds; to the westward, the western limit of westerly winds.
Figures at end of lines show hour of day at which observations were made; 7:35 A. M., 12 M., 4:36 P. M., and 11 P. M., Washington mean time; 7 A. M., 2 P. M., and 9 P. M., local time
87° Long. West from 82° Greenwich


WAR DEPARTMENT WEATHER MAP.
SIGNAL SERVICE, U.S. ARMY.
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.
MAY 30, 1879.
Variable Winds
Area of Westerly Winds
Area of Southerly Winds
Variable Winds
Variable Winds
9 P.M.
11 P.M.
4.35 P.M.
7 A.M.
2 P.M.
12 M.
7.35 A.M.
7 A.M.
9 P.M.
7.35 A.M.
4.35 P.M.
11 P.M.
12 M.
2 P.M.
7.35 A.M.
7 A.M.
12 M.
11 P.M.
4.35 P.M.
9 P.M.
2 P.M.
NOTE.—Lines centrally located show the division of southerly from westerly winds.
Lines to the eastward bound the eastern limit of southerly winds; to the westward, the western limit of westerly winds.
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87 Long. West from 82 Greenwich

THE VELOCITY AND FORCE OF THE WIND.

In trying to obtain factors upon which to base calculations respecting the pressure and velocity of the wind's action upon heavy objects, many difficulties were encountered. Buildings that had been partially destroyed or moved from their foundations were found to have been rebuilt or straightened up, and the *débris* so removed and changed about from its position as the storm left it, that it required unusual precaution in conducting any investigation, which at best would not give sufficiently reliable data.

It was always of prime importance to ascertain definitely, which side or end of a structure or object was first struck by the wind, in order to determine the configuration and inclination of the exposed surface, but such examination was rendered next to impossible by the celerity with which the devastated districts had recovered from the shock of the storm and the lateness at which I arrived at the different storm tracks.

Objects that were reported to have been carried certain distances, could rarely be satisfactorily examined on account of their removal or change in form and position since the storm.

Not one of the cases which I could enumerate, satisfactorily expresses a near approximation to the actual wind velocity manifested in its destruction, and particularly the force exerted within the vortex of the whirling cloud. The center of the storm cloud as near as I could ascertain, very rarely, if ever, came directly in contract with large objects except the timber in forests, where its manifestations could be studied with any important results. Some very interesting and valuable conclusions might in all probability be reached regarding this question by a special examination into particular cases of twisted or broken trees.

Because of the untoward circumstances above enumerated, I have thought it inexpedient to present even a few of the calculations I have made, giving a velocity of from 80 to 150 miles per hour, from a fear of misleading rather than aiding a comprehension of the tornado's power.

Quite as satisfactory and even a better idea can be secured from a perusal of the several storm, descriptions, where considerable care has been taken to give correct dimensions and distances.

WIDTH OF THE PATH OF DESTRUCTION.

This varied constantly at different points in the storm's track, ranging from 60 feet to 90 rods which estimate does not include the boundaries within which anything, however small or weak was blown down, but the path immediately described by the storm cloud. The violent whirl of the air about the cloud as it progressed forward, diminishing in force as distance from the center increased, would throw down fences, break off the tops of trees, or unroof small buildings at a distance of from 1 to 2 miles. The funnel cloud corresponded very closely in its dimensions with the path of greatest destruction. Whenever it descended to the ground its base broadened to a variable width, and with it the path of violence, which again contracted proportionate to the height of the cloud above the ground. The apparent height and comparative width of the top and bottom of the funnel cloud were variously estimated by the different observers, their results depending upon their relative positions respecting the cloud and their consequent angle of vision. For their statements reference will be made to the various storm descriptions. Very few who were directly within the storm's path could intelligently observe the various effects, as their whole attention was directed to efforts for protection and many were paralyzed with fear. The comparative width of the sides of the storm track was a matter very often brought to my attention. The left or W. side was always the narrowest, and, unless within the limits of the path of greatest destruction, the force manifested was always the weakest on this side. I inquired repeatedly if any one experienced strong inward rushing currents on this side which were often mentioned as occurring on the opposite side, but always received a negative answer. The W. side was generally from one-third to one-half as wide as the E. or right-hand side. On the latter side only, the funnel cloud received its unfailing supply of energy from the warm, moist, southerly current, which often rushed with great force towards the funnel, increasing in velocity as its distance from the funnel cloud diminished. The velocity of the SW. current was, no doubt, from 50 to 70 miles per hour, and at times perhaps

greater. This was the straight wind before it arrived within the compass of the whirling cloud, when its velocity was more than doubled by the attending circumstances. The contrast in the width of the opposite sides of the storm's track was noticed by many persons, and was the cause of considerable inquiry. Several persons who were intelligent and careful in their observations, reported that they did not feel a straight but always a circular movement of the air on the W. side, whereas on the right side, people would often say "the wind came straight from the SW."; still the whirl was as often felt on the right side, particularly when near the storm's center. It is a combination of the straight wind with the whirling current from right to left that creates a distinction between the air currents on the right and left sides of the storm track. The comparative width of the two sides is no doubt influenced to a certain degree by the progressive movement of the cloud, which coincides with the direction of wind on the right side, thus increasing its velocity and its power of destruction.

ELECTRICITY.

Characteristically absent from the funnel cloud, it invariably accompanied its incipient stages in the formation of the massive cloud from which the funnel depended. The rain and hail preceding the tornado were not always but generally attended by lightning, not a violent manifestation, but occasional flashes. The most terrific displays were reported during the heavy precipitation which sometimes occurred after the tornado had passed some ten or fifteen minutes. Very often its darting flash was observed as the dark clouds began to rise above the western horizon, an hour or more before the storm. Even while the funnel cloud was whirling over the earth, flashes were noticed in the distance to the SW. and NW. Every person was utterly at a loss to account for the absence of this element in the funnel cloud, and it caused many anxious inquiries, because all observers who had in the least attempted to philosophize upon the terrible manifestation of power presented to them by the destructive effects, were determined to assign it to some mysterious interference of electrical force. Wherever a piece of iron was bent, broken, or twisted, a huge tree torn up by its roots, or clothing snatched from the body, it was attributed to electricity. The fact that it did not appear in the cloud by a flash was explained away by supposing that its subtle presence produced powerful effects through some incomprehensible modification of its usual character. There was a dogmatic predisposition to attribute everything, the result of unusual power, to this one member of the group of physical forces. Of course, it was the easiest way to get rid of a difficult problem. It being generally accepted that little is yet known of the peculiar nature of electricity, there would be comparative safety in assigning the cause of a strange atmospherical disturbance to its wonderful range of power, feeling satisfied that, for a considerable time at least, there would be no probability of a decided advance into the analysis of such a relation. The funnel cloud is a mere collection of clouds of the same rarity as the mass whence they are drawn. Their descent is evidently the mechanical effect of the whirlwind. The latter is caused by the disturbed equilibrium of the warm and cold currents, which, creating a high degree of rarefaction, extending between the clouds and the earth, cause them to descend within the rarefied area by their gravity, or by the pressure of the surrounding clouds and of the air. The contortions of the descending mass of vapor, and the violent whirlwind felt at the earth, as well as the appearance of the commencement, increase and decrease of the mass, all demonstrate the whirl of the air to be the mechanical cause. The same vortex, whirl, or eddy of the air which occasions the cloud to descend, determines the character and rapidity of ascent of the loose bodies on the earth. If the surface upon which the funnel descends is water, the same mechanical power raises a body of foam, vapor, or water to the clouds, and the cylindrical mass becomes a waterspout. There is not the slightest difference between this and a tornado; the contrast only exists in the material acted upon. As soon as the vortex or whirl exhausts itself, the phenomena terminates by the fall to the earth of the light bodies or water, and by the ascent of the cloud. The degree of the mechanical power manifested depends upon the size of the vortex, moisture of the warm current, the rapidity of its ascent, and the contrast of temperature between it and its opponent, the cold current. As the warm current passes into the vortex, its rapidity of ascent is contributed to by the degree of the cold of expansion and the latent heat liberated by condensation, which together assist in the formation of a high degree of rarefaction, necessary to the violent rush and whirl of the air. It is

plainly evident that the movement of a current of air at the rate of 200 or 300 miles per hour is sufficient to demolish the strongest building, and it is equally evident that a high degree of rarefaction between the clouds and the earth, produced within the limits of a few hundred yards, is the competent agent of such a force. Even if electricity was present there is no need of its intervention to produce the force required. Whatever its cause or function in the thunder storm, there is no faithful evidence of its existence in the tornado.

UPWARD AND DOWNWARD CURRENTS.

Numerous instances were given in evidence of the existence of a remarkable degree of force exerted upon bodies of considerable weight, carrying them to unusual heights and with great velocity. Several cases are referred to in the descriptions of the storms, where persons were carried out through the tops of buildings, after the roofs had been removed. Also where even a more powerful force was exhibited, as in the case of Mr. Condray's house, in the Stockdale tornado, where the roof was lifted to a height of nearly 300 feet. Again, in the Irving storm, where Mr. Robert Patterson reported the upward pressure at the center of the cloud, extending its influence even to the extreme edges, as illustrated by its effects upon a man's weight, and upon lighter articles, like straws, shavings, &c., moving upward without any apparent action of the wind. Almost every person who watched the cloud for any length of time had occasion to mention the presence of *débris* in the funnel, and of its being drawn upward through the center of the cloud and thrown outward at the top. Wherever the center of the cloud was seen to pass directly over loose objects (when not too heavy), they would shoot upward with lightning rapidity. The presence of downward currents was not by any means so well apparent. I obtained no well authenticated instance of any object being thrown to the ground by the individual effort of a downward current. Small clouds were seen to dart down the outer sides of the funnel whenever they floated in close proximity; but their motion was indirectly the result of a strong upward movement in the vortex of the cloud, exerting a violent centripetal action extending some distance from its circumference, and increasing in intensity from the top downward. From the very nature of this peculiar combination of opposing currents and consequent cloud formation, no downward current can be expected to form. The funnel is formed, fed, and maintained by the rapid ascent of continued warm and moist currents, whose moisture is condensed by the cold of expansion and elevation, liberating latent heat and thereby accelerating the powerful upward movement, which constitutes the principal current of the tornado. There are several motions to the storm cloud, resulting directly or indirectly from the action of this current, particularly the rising and falling motion, which is caused by the violent inrushing and upward movement of the warm current, which, as a natural effect, would cause the light cylindrical cloud to shoot upward or sway from side to side. Several cases occurred where objects and animals were dashed to the ground with great violence, but nearly always at an angle of from 30° to 40°, showing that they had first been lifted from the ground by the upward current, and thrown forward by the progressive velocity of the storm, or a violent outward movement of the whirl. Where objects were broken to pieces in falling or being driven into the ground, or animals had their bones broken, it indicated no greater force than could be attributed to gravity. A person may be very easily misled into the conclusion of the existence of a strong downward current, because of the violence with which objects raised to a considerable distance in the air strike the earth, particularly if the circumstance is but casually noticed, while closer examination will reveal the fact that its movement is the result of the violent inrushing current, or the progressive velocity of the storm.

DIRECTION OF THE WHIRL.

Without a dissenting voice the various observers united in declaring the motion to be from right to left. The relative position of the fallen trees and the scattered *débris* on the opposite sides of the storm's track bear indisputable testimony to the truth of their observations. There were instances among the prostrated trees, especially near the storm's center, where the direction of their tops would form an exception to this characteristic direction, but the accompanying circumstances were sufficiently cogent to explain the anomaly. Trees falling from the influence of the

violent whirl near the center would necessarily mingle in such confusion as to prevent the possibility of their downward movement coinciding with the direction of the wind. The greater the distance from the center, up to a certain degree, the more regularly were the trees prostrated, and consequently their more faithful correspondence with the direction of the revolving current of air. In the case of buildings there was no difficulty in observing the distinct and invariable direction of the whirl, because, unlike the trees they presented but a single object to be acted upon within the area of disturbance. The second Irving storm presents peculiarities in this respect and in several others, which cause it to differ materially from the first Irving storm or any of its companions. To my mind the second storm was not a completely developed tornado, otherwise it would have asserted undeniable characteristics and not remained isolated in nearly every respect but its destructive power. Its complete history is given under the head of the "Irving tornado," where a study of its manifestations can be made.

RAIN AND HAIL STORMS.

In referring to the several storm descriptions, it will be found that rain and hail invariably preceded the tornado cloud from ten to thirty minutes, nearly always attended by a southerly wind. The rain was light but in large drops, and the hail presented the same peculiarity, with this addition, that most of it seemed to fall on the N. or left-hand side of the storm's center, probably due to the fact of the strong southerly current carrying the stones, as they dropped from the hail cloud, beyond it to the N. It was seldom that hail followed the passage of the tornado cloud with a change of the wind to the W., but rain did so with scarcely an exception and often very heavy. If hail did follow, it was always very small, but in large quantities and covering a much wider path than that left by the tornado. It is especially important to note that every one of the several tornadoes were preceded by a precipitation of hail, and when the funnel cloud lost its identity the hail storm still continued, evidencing the truth of what has been surmised, that a tornado is a hail storm cloud of unusual intensity, reaching the surface of the earth. There may be a violent opposition of warm and cold currents above the surface of the earth, forming the hail cloud, producing a whirling movement and a cylindrical cloud, within which similar manifestations of a variety of forces obtain, as in the true tornado cloud. An important lesson can be drawn from the comparative size of the hailstones that fell before and after the passage of the funnel cloud, illustrating the relative power of the centripetal current and the rapidity of condensation as performed within the cloud vortex. It will also be noticed that the first precipitation of hail embraced a much narrower path, being coincident with the path of greatest destruction, while the second precipitation was generally from 3 to 5 miles in width. This seems to plainly indicate that the formation of the largest hailstones accompany the manifestation of the greatest centripetal power, and also that the funnel cloud does not necessarily, because of its transformation, include the entire breadth and capacity of the hail cloud. This idea would again seem to be substantiated by the fact that several persons saw more than one funnel at a time depend from the same circumscribed cloud, but eventually combining in one. There were instances where no hail but only rain fell after the funnel passed, which would seem to indicate that here the tornado and the hail cloud occupied the same area. There were no well authenticated cases where all precipitation did not cease at every locality immediately preceding the passage of the funnel cloud. Everything gave way to the boundless power and velocity of the dark cloud.

EXPLOSIVE EFFECTS.

I made diligent inquiries respecting the occurrence of any manifestations of this character, but failed to elicit any evidence in proof of its existence. Those buildings situated directly within the center of the storm's path were of course torn to pieces almost instantly, while those on either side, where such effects might be expected, generally had the doors and windows all open because of the intense heat, and succeeded in shutting but a portion of them before the storm began its work of destruction. Had buildings been closed, which in all probability would have been the case in cooler weather, opportunity would then have been afforded for the sudden displacement of the surrounding air. Under these conditions the building quickly relieved about its exterior from

the support of an equally distributed body of air would, through the resulting action of the inclosed mass of the same material, seeking to restore the disturbed equilibrium, be thrown violently apart, the sides and top going in various directions. Again, throughout all of the storm tracks, the most of the *débris* was gathered up in piles about the foundation, or entirely carried away, so that it was impossible to pass judgment upon the character of the destruction. This was a great hinderance to rapid and complete work, and one of the chief difficulties encountered in my investigation.

DURATION OF TORNADO.

The time of passing any point was variously estimated from five seconds to two minutes. "Quicker than thought," was an expression often used as conveying the observer's idea of the rapidity of destruction. Estimating the average diameter of the cloud at 150 feet, and its average velocity at a mile in two minutes, we have its mean duration at any one point, about ten and a half seconds. There were times in the passage of the cloud when it appeared to remain almost stationary, whirling upon its narrow base like a top; again it was reported as moving no faster than a horse gently galloping, but only for a half a mile or so, when it would make up for lost time by dashing forward at a rate of 50 or 60 miles per hour, and then gradually working down to its accustomed velocity of about 30 miles per hour.

TOPOGRAPHY.

In accordance with instructions, I have prepared a series of maps, giving, as well as the time and material at my disposal would permit, a general idea of that region of country over which the several storm tracks are located. Each map embraces from 6 to 10 square miles of territory on either side of the immediate storm center, so as to afford a fair opportunity to comprehend the prevailing character of the surface. It will be observed that there is a marked similarity of general features presented, not only among the several Kansas storm tracks, but in one State as compared with another, and the lesson to be drawn from this peculiarity is two-fold. In the first place, such maps of limited superficial areas do not and cannot present points of topography adequate to a clear and faithful investigation of any supposed connection between the *origin* of this class of storms and the contour of the surface. Bear in mind that I refer to the *origin*, and not to the manner in which the tornado cloud already formed may be influenced by the irregularities of the surface. A map prepared to show the entire topography of that portion of the United States included within the meridians of 89° and 101° would plainly illustrate an important truth in the tornado problem, viz, that there is not another section of our vast domain wherein there exists opportunities so unlimited for the unobstructed mingling and opposition of warm and cold currents and currents highly contrasted in humidity. As an area of low barometer (not necessarily a storm area) advances to the Lower Missouri Valley, warm and cold currents set in towards it from the N. and S. respectively, which, if the low pressure continues about stationary for some time, ultimately emanate from the warm and moist regions of the Gulf and the cold and comparatively dry regions of the British Possessions. Here lies the key to the marked contrasts of temperature and moisture, invariably foretelling an atmospheric disturbance of unusual violence, for which this region is peculiarly fitted by nature, and in apparent recognition of which it has received the euphonious title of the "battle-ground of tornadoes." It cannot be disputed that, so far as the history of tornadoes is concerned, the majority have occurred over this region, and why? Because of its peculiar topography. From the Gulf northward to the central portion of the Lower Missouri Valley, and from the British Possessions southward to the same locality, there is permitted an entirely free movement of the air; nothing in the shape of earth or water exists to modify its character, except, perhaps, to intensify the contrast of attributes. That this is a fact, I need only to recall my own experience and the united testimony of the inhabitants as to the monsoon character of the winds in Kansas and Western Missouri. Over Texas, Louisiana, Arkansas, and Indian Territory occurs a broad expanse of rolling surface; sometimes abruptly hilly, but on the whole presenting a sameness of outline to a marked degree. Similarly conditioned are the States of Minnesota, Iowa, Nebraska, and the eastern half of Dakota Territory. West of the 101st meridian we find a rugged and abrupt country, traversed by great mountain chains, which deflect the course

and modify the temperature and moisture of passing currents. On the east side of the 89th meridian, the Great Lakes introduce an equally important factor into the modification of passing currents. The second lesson (a positive one) is that these small maps perform the important function of portraying the actual relation existing between direction of movement, as contrasted with place of origin of the tornado cloud. In this connection it will be seen that the funnel preserved its characteristic NE. course at the expense of every other accompanying circumstance. The cloud might and did in several instances change its course, apparently through the influence of intervening elevations, as in crossing the Blue River at Irving; but whether this change in its course was due to the interception of the Bluffs, or that at that moment the elastically suspended funnel received a fresh influx of warm and violently inrushing air from the S., is a question which can only be settled by actual observation. The funnel was several times noticed to change its course on the highest ground, and perhaps did so as often as in the ravine. I made particular inquiries and examination into such cases where it was possib'e, and found that almost without an exception I was able to obtain some, and, in a few cases, indubitable, evidence that the change of direction followed a violent inrushing movement from the S. Houses were destroyed with as great violence and completeness upon high land as upon low land, but the largest number were wrecked in ravines, because it is the prevailing custom of this region of country to select building spots along the low bottoms of a stream for convenience to water and timber, and for protection from the continued heavy winds that break over the open prairie. In several instances the funnel cloud passed from one ridge to another, doing damage on both, but skipping the intervening depression; then again it would follow a high "divide" for several miles. The ridges and valleys were almost always crossed at right angles, as their courses were generally from NW. to SE. As to the formation of gaps in the storm track, comparatively few occurred, and those that did, as many times included valleys as ridges. The ascent or descent of the tornado cloud was always gradual and in a long, swinging, swaying motion, as if caused not so much by the influence of the configuration of the earth's surface as perhaps the current of air from the S., acting singly or combined with the conflicting movement of the currents within the vortex. Several times when rising over high ridges the cloud, after reaching the top, would remain above the ground a few minutes before descending, when again its work of destruction would commence. The region over which the tornadoes occurred, both in Kansas and Missouri, is thickly traversed by creeks, with generally quite abrupt boundaries or ridges from 75 to 300 feet in height, and bottoms varying from one-fourth of a mile to 2½ miles in width, to which I have called special attention in the description of each storm. In Kansas the storm tracks were, without an exception, confined to what is known as the 2,000-foot level, coinciding with the "middle rain-belt" as determined by the State meteorological bureau. This belt receives a yearly precipitation next to the heaviest or "eastern rain-belt," but for the month of June, 1879, considerably the largest as compared with the eastern and western rain-belts, corresponding respectively with the 1,000 and 3,000 foot levels. In reference to the relation between topography and the storm track in Jackson County, Missouri, I produce a portion of a letter in reply to inquiries addressed by me to Maj. E. A. Hickman of Independence:

> As far as is known, all of the tornadoes that have entered our county came from one of the water divides that head up on that great watershed E. of the Rocky Mountains and W. of the Missouri River. These smaller divides and their streams head up and out on other divides, and they in turn head on the high watershed that begins on the top of Pike's Peak and winds on to the Missouri River, N. of Independence, shedding first its mountain waters into the Platte River on the NE., and the Arkansas River on the SW.; then as it comes nearer it continues to divide the streams that head on it into those that run NE. and SW.

The tornadoes both N. and S. of the Missouri River, as a general rule, followed the "divides" between the streams, not so much, perhaps, because they were elevations as that their course was from SW. to NE., and thereby necessarily coincided with the characteristic course of the tornado; while in Kansas, the course of the "divides" being from NW. to SE., they were crossed at right angles.

CASUALTIES AND LOSSES.

I found it a subject of no little difficulty to ascertain what might be considered a fair estimate in this matter. Newspaper reports were frequently very much exaggerated, and the statements of individuals were affected with a certain degree of indefiniteness that made them unreliable.

However, I have endeavored to combine the results of my own inquiries with the reports of relief committees, newspapers, and individuals, so as to arrive at a close approximation to the truth. The total number of persons killed number 42, and the wounded 185. This result comprises only the work attendant upon the destructive agency of the tornadoes. The severe local storms which occurred preceding and following the tornadoes would not add more than three or four to the list of killed, but it would increase the number of wounded to upwards of 250. The loss of property, including timber, crops, buildings, farming implements, furniture, &c., embracing that caused by the local storms as well as the tornadoes, will reach nearly $1,000,000. I estimated 262 houses as destroyed, which if changed to the word "buildings," would more than double the number. These numbers may appear comparatively small when considered with the large number of tornadoes reported, or as compared with the disastrous results of smaller tornadoes that have occurred at various times in the Eastern States. It must be remembered that these storms, especially in Kansas, passed over very new and thinly settled districts, and that only in one instance was a town actually entered by a storm track, which town contained but 300 inhabitants. Many towns were passed, but nearly all were within a safe distance. Even this loss is a terrible calamity to befall young and feeble communities struggling for a foothold in the vast prairie wilderness. The effect upon the people was pitiful in the extreme. Night after night (particularly in Kansas) hundreds of people never went to bed, but remained dressed and with their lanterns trimmed, watching for a fresh onslaught which they expected momentarily. Every dark cloud or sudden increase in the velocity of the wind seemed to them filled with evil forebodings which could not be allayed until every vestige of supposed danger had vanished. The terror depicted upon the countenances of the bravest men, at the sight of a dark cloud above the horizon, was something beyond description or realization, except by those who could witness ther excitement. Persons were preparing to quit the country; business of every kind succumbed for a season, except that of generously supplying the wants of the sufferers by well organized relief committees. Many acts of devotion and self-sacrifice redound to the glory and honor of Kansas people. It was a matter of the most serious consideration, and of oft-repeated inquiry, whether or not this region was particularly subject to this class of storms, and the frequency with which they might and would occur. Could the question be settled? Would it be settled by the Signal Service Bureau? Does the Signal Service Bureau pay particular attention to this class of storms, so intimately affecting our welfare? Will the bureau be able to forewarn us next spring and summer? These and similar questions were earnestly propounded by the active business men of every community, both within and outside of the storm's path. Permit me to suggest that it would be advisable, and without doubt practicable, to station a special observer during the months of May, June, and July at Kansas City (a point easily communicated with from any part of the Lower Missouri Valley), who shall receive special reports and instructions from Washington regarding atmospheric disturbances, and report the same to the various telegraphic stations throughout the valley. On the occurrence of a tornado or other violent local storm, this observer would be able to visit the track within the shortest possible time after the storm's passage. Although having a meteorological bureau of its own, Kansas recognizes the truth that it is only one of the factors, of which the Signal Service Bureau is the composite head, and that to properly investigate and prepare for these storms it is absolutely necessary that a study of the atmospheric conditions of the entire country should be prosecuted in order to protect the vast agricultural interests of one of the most productive and promising States in the Union. Here is an opportunity for the Signal Service Bureau with the aid of its efficient chief, to enter upon a field of inquiry as grand in its possibilities (because of its great utility) as any effort of the kind yet meditated.

A plan contemplating the furnishing of reports to the cotton districts of the South, giving the proprietors of that great industry the earliest information as to the probable occurrence of frost, would be a great and beneficial undertaking, but not more so than a well-directed attempt to meet the needs of that great section of the West, the Lower Missouri Valley. The frost will come in spite of the prediction, so will the tornado, but to get the right information to the proper point before the occurrence of the dangerous phenomenon, thereby affording opportunity to provide against its ravages, is the great desideratum. It can be done.

OTHER STORMS OF MAY 29 AND 30.

In connection with the distinctive tornadoes very violent storms of wind, rain, and hail visited portions of Kansas, Missouri, Nebraska, and Iowa.

On the 29th, in Central Kansas, clear or fair weather generally prevailed; but the eastern portion of the States of Nebraska, Iowa, and Missouri, lying adjacent to the Missouri River, were visited by severe local storms and tornadoes between 3 and 6 p. m.

On the 30th rain commenced falling as early as 10 a. m. in Central and Northwestern Kansas, resulting in severe hail and wind storms between 1 and 2 p. m., and tornadoes between 4 and 6.30 p. m. In Southeastern Kansas and Western Missouri rain commenced early in the day, followed by tornadoes and several local storms between 3 and 5 p. m. In Northwestern Missouri and the adjacent territory of Kansas, Nebraska, and Iowa, the heaviest storms occurred from 6.30 to 9.30 p. m. A heavy storm was reported in Southeastern Iowa between 2 and 3 p. m.

Beloit, Mitchell County, Kansas, 30th.—Storm struck town about 2.30 p. m. Several houses were blown down or unroofed. Large trees on the banks of the Solomon were twisted or wrenched in two. Hail of unusual size fell during the passage of the storm, which seemed to be the most violent to the westward.

At Cawker City.—The Cawker City Free Press described the storm as the "most destructive over known here. Seven buildings were totally wrecked and several persons injured." Hail fell measuring 8 to 10 inches in circumference.

Scandia, Republic County, Kansas, 30th.—Storm broke out at 4 p. m. Every house in town was shaken, the cellars flooded, and much damage committed. Several miles southeast of the town severe destruction to property occurred in the country. Storm came up with a heavy NW. wind and lasted about three hours. Track about 3 miles wide, following the Republican River, from NW. to SE.

Centralia, Nemaha County, Kansas, 30th.—Heaviest rain and wind storm for several years passed over this town about 8 p. m., tearing down fences, barns, houses, trees, and everything in its path. Course of storm from W. to E.

AT CENTRALIA.

CENTRALIA, *May* 31, 1879.

To the Editor of the Champion:

A frightful storm of wind and rain passed over this village last evening, doing serious damage to property. About 6 o'clock a very black cloud appeared in the SW. At first we thought the storm would go to the N., but by 7 it was evident that a gale was upon us. At 7.30 p. m. its violence culminated, and at our house, a mile NE. of the village, large limbs were flying from the cottonwoods and every movable thing was upon the whirl.

A chicken coop was taken from the NW. side of the house, and this morning we found it several hundred feet to the SE. of it. But the storm seems to have spent its violence on the farm of Mr. A. W. Slater, which is being cultivated by Mr. Nightengale. The house in which N. resided was in a moment made a complete wreck. Every window, save one, was broken in; a part of the roof was blown off, and torrents of rain came rushing in. A child, dangerously sick, was taken over to the nearest neighbor's in the midst of the storm. The barn was blown down with the sheds, and the flying timbers hurled among a herd of cattle in the yard, breaking off the horns of several cows and maiming others seriously. One hog had his fore shoulder broken. The farm wagon was turned bottom side up, and completely smashed.

The grove of fruit trees and cottonwoods, one of the oldest and most beautiful in the country, is ruined. Large trees were twisted off as though they had been twigs, and many fine bearing apple trees and others were torn up by the roots. All the wood fence in the neighborhood is demolished. Indeed, the whole place is a complete wreck, causing serious loss to all concerned.

Upon the place occupied by Mr. Griffiths, and owned by Mr. Peter Clipinger, the barn was very badly damaged. The roof was blown off, and the entire building is a wreck. A large amount of fencing upon this farm is destroyed, as is also upon the home farm of Mr. Clipinger. Fortunately, so far as heard, no lives have been lost. Rumors reach us of serious damage elsewhere, but we have no details. The storm continues but without the violence of last night.

Yours, GEO. B. LINCOLN.

Rev. G. W. Goodale, pastor of the Presbyterian church, Pawnee City, Pawnee County, Nebraska, reports, on May 30, a very severe storm of wind, rain, and hail from the NW. at 7 p. m.; heaviest wind lasting about fifteen minutes. Several houses were blown down in the city and also in the adjoining country to the SE.

It will be of interest and importance to call attention to some peculiarities that developed themselves in connection with a study of the character and position of the local rain and hail storms. On the 29th they were confined, as before stated, to Eastern Kansas and Western Missouri; their invariable direction was from SW. to NE., averaging about 6 miles in width and from 18 to 25 in length. I was able to carefully locate no less than nine of these storms from numerous letters received in answer to inquiries directed to postmasters and others upon the subject. The several tracks were separated by distances varying from 5 to 18 miles, except one instance of 35 miles. On the 30th the hail storms, rather more numerous and of greater width and length, came invariably from the WNW. and passed to the ESE. In this connection, and as a means of explaining the different directions pursued by the hail storms on the two days, it will be of importance to consider the relative position of the area of low barometer as presented by the Signal Service weather-maps on those days at the hour of 4.35 p. m. On the 29th the low area occupied the northern portions of Nebraska and Iowa, and the southern portions of Dakota and Minnesota, drawing over Kansas and Missouri warm southwesterly winds. Without an exception, every report concerning a hail storm stated that the cloud first appeared in the SW., preceded from one-half to two hours by a SW. wind. In some cases it had been the prevailing wind for the day. One person remarked that he had never before seen a hail storm come from the SW.; always supposed them inseparably connected with a NW. wind.

On the 30th a second low area had formed to the SE. over Indian Territory, Texas, and Arkansas, while the first area had moved to the Upper Lake region; thus on that afternoon cold northwesterly currents had taken the place of the warm southwesterly currents on the day previous. The first hail storms were formed by the opposition of cold northwesterly and warm southwesterly currents, causing them to pursue a northeasterly course, while the second were formed by cold northwesterly and warm southeasterly, producing an ESE. course. This would seem to illustrate the truth that the course of these peculiar atmospheric disturbances, which arise from the opposition of warm and cold currents, depends upon the relative position of the warm current. From this we might conclude the reason of the characteristic NE. course of a tornado. It is an exception to find them pursuing an E. or ESE. course, because their movements are controlled by the energy-supplying force, the warm moist current which prevails from the SW. between N. latitudes 30 and 64. While these prodigious storms (tornadoes and hail storms) were devastating nearly the entire Lower Missouri Valley, a protracted and severe drought obtained in the southwestern part of Kansas, embracing a territory of 130 square miles, and having a general altitude of 3,000 feet. Such serious proportions had the effects of drought assumed, that a proposition to convene the legislature was considered by a convention of organized committees. This section forms a part of what is termed by the Kansas Meteorological Bureau as the "third or western rain-belt," whose mean annual rainfall is 19.48 inches, about 41 inches less than the combined mean of the central and eastern belts, which are respectively 23.61 and 37.07. Nearly the entire region forms a portion of the unorganized counties of the State. As compared with the middle and eastern divisions it is but poorly watered, having but one main stream, the Arkansas River, which has a very limited number of tributaries until it reaches the 98th meridian.

OTHER TORNADOES.

Mr. T. B. Hanna, of Raymore, Cass County, Missouri, kindly furnished me considerable information and assistance in obtaining some of the following data:

July 16, 1878, about 2 p. m., course from SW. to NE., passing along one of the branches of Grand River, 3 miles N. of Raymore. Track from 80 to 100 feet wide, and about 7 miles long. A funnel-shaped cloud whirling rapidly and sweeping everything before it.

July 20, 1876, about 4 p. m., a tornado passed 2½ miles S. of Raymore, over the ridges and across the valleys, destroying several buildings. One house was blown down, and the inmates thrown in several different directions from 100 to 150 feet, killing one lady and badly injuring

another. Another house had its sides thrown outward as if by an explosion, and the ground floor left with a stove standing in the center. Still another house was destroyed, killing a child in its mother's arms, and distributing the ruins of the building in every direction, over several acres. Width of track about one-fourth of a mile, and course from W. to E.

June 28, 1873, about 3 p. m., through the northern portion of Cloud County, Kansas; course, W. to E.

June 12, 1877, in the afternoon, through the northwestern portion of Cloud County, Kansas; course, NW. to SE.

July 4, 1860, about 5 p. m., in Doniphan County, during the year of the great drought in Kansas, destroying a great deal of timber along the Missouri River.

November 8, 1870, a cone-shaped cloud, accompanied by a loud roaring noise, and great tumult in the clouds, crossed the Republican River near the mouth of Buffalo Creek, and passed northeastward over Republic County, Kansas, into Nebraska, doing great damage, especially in the latter State.

Mr. John Flagg, a resident of Manhattan, Kans., but who at the time was at Salina, Saline County, reported to me as follows:

June 6, 1876, at 3.30 p. m., a tornado passed over the northern portion of Saline County, commencing in the eastern portion of Ellsworth County; course, from SW. to NE., and length about 40 miles. Eleven persons were killed, many wounded, and $30,000 worth of property destroyed. The cloud did not follow any ravine, but crossed depressions and elevations alike. It passed at a considerable height over the town of Salina, letting down a large quantity of *débris*. Three other tornadoes were experienced on the same afternoon, in different portions of Saline County, at points from 8 to 10 miles apart. No. 1 passed along the "divide," between Smoky River and Gypsum Creek; course, from SSW. to NNE.; length, 12 miles. No. 2 took a northeasterly course along Dry Creek for about 10 miles. No. 3 crossed Mulberry Creek, near the town of Mulberry, in Pleasant Valley Township. Previous to the occurrence of these storms there had been a continued dry period for several weeks, with warm southerly winds, which became very strong the last three days.

June 20, 1859, p. m., a tornado crossed the Solomon River in the southern portion of Ottawa County; course, from SW. to NE.

June 14, 1866, 4 p. m., a tornado passed, from SW. to NE., over the central portion of Page County, Iowa.

August 18, 1858, p. m., a tornado passed over Iowa City, Iowa, from SW. to NE.

June 16, 1863, p. m., a tornado, following the course of Wolf River, in Doniphan County, Kansas, crossed the Missouri River, and passed northeastward through the southern portion of Holt County, Missouri. The SW. wind was the most powerful and damaging, and the worst destruction was committed in the lowest places.

Maj. E. A. Hickman, of Independence, Mo., very kindly furnished me with the following report of two tornadoes in Jackson County, Missouri:

October 25, 1844, 6.30 p. m., a violent tornado passed through the northern portion of Jackson County, along a ridge S. of the Missouri River, 450 feet above the water, in a course N. 56° E., from SW. to NE. It entered the State about 1 mile S. of the small town of Westport, and passed over the town of Blue Mills, on the Missouri River, 10½ miles distant. For two months previous to the storm the weather had been exceedingly dry, with monotonous southerly winds. Within a few days of its approach the southerly wind grew warmer and stronger, with a haziness in the air, casting a pale, sickly light upon every object around. The sun looked like a vast ball of fire hung in the air. During the day, until about 5 p. m., the atmosphere was very quiet, at times intensely calm. At 5 p. m. a breeze sprung up from the S., followed by the rapid appearance of a dark portentous cloud in the W. The greatest destruction was found on the highest places, it seeming to pass over valleys without descending. All of the *débris* on the E. side of the track lay to the NE. and N., and on the W. side to NW., W., and S., as though the destroying agent moved in a spiral course from right to left.

No. 2 was reported by the Indians to have occurred during the spring of 1814. Its destructive path through the timber was easily identified twenty-five years afterwards. In 1826 the first government survey of the Territory of Missouri records the position as follows: "10 chains W. from

another. Another house had its sides thrown outward as if by an explosion, and the ground floor left with a stove standing in the center. Still another house was destroyed, killing a child in its mother's arms, and distributing the ruins of the building in every direction, over several acres. Width of track about one-fourth of a mile, and course from W. to E.

June 28, 1873, about 3 p. m., through the northern portion of Cloud County, Kansas; course, W. to E.

June 12, 1877, in the afternoon, through the northwestern portion of Cloud County, Kansas; course, NW. to SE.

July 4, 1860, about 5 p. m., in Doniphan County, during the year of the great drought in Kansas, destroying a great deal of timber along the Missouri River.

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MAP

of the

TRACKS OF SEVERAL TORNADOES

through

JACKSON COUNTY, MISSOURI.

NOTE.—Showing their positions relative to lines of greatest elevation.

town. 49 N., range 32 W., and 30 chains N. from NW. corner of same town., pursuing a course N. 30° E." The storm passed along the high divide, between the waters of the Big and Little Blue, crossing the path of tornado No. 1, near Wayne City, striking the Missouri River at Blue Mills.

May 18, 1877, p. m., a tornado passed from W. to E. along the line between Ottawa and Saline counties, Kansas, destroying a great amount of property.

February 23, 1875, 3.40 p. m., a tornado passed over the town of Houstonia, Pettis County, Missouri, demolishing it, lifting freight-cars from the railroad tarcks, and causing considerable loss of life; course, from SW. to NE.; breadth of track, 300 yards. A large amount of timber was destroyed N. of the town on Black River.

June 26, 1874, p. m., a severe tornado passed near Coffeyville, Montgomery County, Kansas, committing considerable damage; course, from SW. to NE.

June 22, 1874, p. m., a tornado passed near the town of Towanda, Butler County, Kansas; course, from SW. to NE.

The following communication from Mr. Weisbard, of Irving, Kans., is full of interest:

On July 31, 1860, 3.30 p. m., with the thermometer at 102°, and a medium strong current from the S., a dark cloud suddenly developed in the NW., which, in a few minutes, changed into a dark gray cylindrical mass of vapor, which swept with terrible force and velocity down the valley of the Blue River, N, of Marysville, in Marshall County, Kansas, unroofing houses, uprooting trees, carrying away fences and all vegetable products from the fields. When it struck the town of Marysville it filled the air with dust and a dark mass of clouds, until it seemed like midnight. The first crash burst in the front door of my store, and then carried the roof off. I went out the back door to save my trunk, when the wind hurled me S., towards my stable, where I grasped an elm post, around which I was several times whipped, but managed to hold on until the storm was over. A gentlemen, now living in Chicago, was taken from my side and carried several hundred feet over the ruins of a house and deposited in Spring Creek Valley. On the prairies in the center of the storm track, the grass was completely stripped, as in winter after the prairie fires. There were seven houses destroyed in the town, and two persons seriously injured. Succeeding the passage of the dark cloud, a violent gale set in from the NW., accompanied by heavy rain and hail, lasting about forty minutes, and chilling the atmosphere to a painful degree.

June 3, 1860, p. m., a most remarkable tornado passed from near the center of Iowa, eastward, to the Mississippi River, destroying the cities of Comanche and New Albany. It passed thence more than half way across the State of Illinois, exhausting its energies on a rocky ridge near the town of Paw Paw, in De Kalb County. As it ascended the elevation, it is reported that heavy bowlders, weighing from 10 to 20 tons, supposed to have lain there since the glacial period, were turned out of their beds and rolled up the ridge several rods.

On June 9 and 10, 1879, while pursuing my investigations of the storms of May 29 and 30, 1879, a series of violent storms visited Central and Eastern Kansas and Western Missouri, doing a large amount of damage to property, killing several persons and injuring a large number. Small tornadoes were reported in several portions of Central Kansas during the afternoons of the 9th and 10th, but the heaviest and most destructive disturbance occurred on the evening of the 10th, between 8 and 10 p. m., as a terrific storm of rain and hail from the NW., moving to the SE. in narrow belts of from 6 to 10 miles in width, over a territory 340 miles long by 260 miles broad. In this storm fell the ill-fated town of Delphos, in Ottawa County, Kansas. Thirty-seven buildings were torn to pieces, and those remaining were moved from their foundations or twisted out of shape. People who had succeeded in partially recovering from the devastating fury of the first storm (May 30) were again desolated. No one was killed, but sixteen persons were seriously injured, and $30,000 worth of property destroyed. The storm was particularly severe at Cawker City, Beloit, Onaga, Topeka, Wichita, Emporia, Ottawa, Seneca, Lawrence, and Leavenworth, in Kansas; at Kansas City and in the northwestern counties of Missouri. The destruction caused by the hail was especially severe, as the stones were of remarkable size. Most of them were as large as hen's eggs, many were picked up weighing from 12 to 14 ounces, and some were reported to have been found the size of bricks, which, judging from the large holes made through the sides of frame buildings, through tinned roofs, and the heavy canvas covers of stage coaches, were not exaggerated in dimensions.

TECHNICAL NAMES.

It is a matter of no little importance that distinct and well-defined terms, closely adhered to, should be applied the several kinds of atmospheric disturbances collectively called storms but individually designated as cyclones, tornadoes, whirlwinds, waterspouts, hail storms, and thunder

storms. It may be thought hasty and ill-advised to insist upon an arbitrary nomenclature in regard to storms when their peculiar characteristics and their more intimate nature have but for a short time been open to scientific inquiry. Yet enough is already known to justify resort to a well-defined name quite as reasonable and exact as those applied to the several cloud formations. Two or more storms may combine so as to act to all appearances as one, yet as well may two or more kinds of clouds exist in the same manner, but the whole is invariably considered by a separation of its parts. It is not that we lack the coinage of suitable terms, but that having them we fail to insist upon their absolute use for the undeniable advantage of clearness and rapidity in investigation. It cannot be denied that the class of storms which I have been ordered to investigate, are *tornadoes* and nothing else, their unfailing accompaniments being quite fully exposed in this report, as well as in others of earlier date. That they are not cyclones, whirlwinds, or waterspouts is evidenced by the manner of investigation and the results of the labors of this office. I refer here to various cyclones, properly so called, which from time to time have been to a certain degree, carefully analyzed in the publications of the office of the Chief Signal Officer. I was repeatedly asked to define the nature of a cyclone and a tornado, and to state why it was that the two terms, which apparently indicated different atmospheric disturbances, were constantly interchanged in their use. It was considered very strange that two apparently distinct classes of storms could be the same whenever any one chose to make them so by a mere effort of the tongue. The people naturally look to this office for the decisive settlement of all such questions, and invariably manifest the utmost confidence in and reliance upon the labors of the Chief Signal Officer, pointing with pride to the zeal and ability with which meteorological knowledge of practical value has been disseminated. As indicative of this sincere appreciation and interest in the work of the office, I take pleasure in acknowledging the receipt of the most uniform courtesy and hospitality during the progress of my work. Assistance of importance was willingly rendered me by many persons which space will not permit me to make mention of here. Especial note should be made of the exceptional kindness of Mr. John A. Martin, editor of the Atchison Champion; Maj. E. A. Hickman, United States land office, Independence, Mo.; Mr. J. A. Shaw, attorney at law and land agent, Lee's Summit, Jackson County, Missouri; Dr. F. A. Ballard, Independence, Mo.; Colonel Van Horn and Colonel Case, Kansas City, and Sergeant S. W. Rhodes, United States signal office, Leavenworth, Kans.

JOHN P. FINLEY,
First Class Private, Signal Corps, U. S, A.

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